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Accuracy in Airplane Propeller Making—I

FRED H. COLVIN
Editor, American Machinist

Substitution of metal for wood in airplane propellers necessitated the introduction of modern machine tool equipment as shown herewith

ADVANCES in aviation are typified by propeller improvements. Just as metal has replaced wood in fuselage and wing construction, so have metal propellers crowded out the laminated wood that prevailed a few years ago. Instead of woodworking machines propeller building now requires modern machine tool equipment, especially propellers having a controllable pitch like those now made by the Hamilton Standard Propeller Co., East Hartford, Conn. Some of the machines and fixtures used in their manufacture are shown herewith.

Beginning with the barrels in which the moving units are housed, we get an idea of the strength required by noting that they are of SAE chrome-vanadium, 6135, which Brinells from 290 to 320. This requires high-speed tools which cut at about 40 ft. per min. The barrel for a 3-bladed propeller is seen in Fig. 1, in the fixture used for the first operation, grinding the mating surface on a Blanchard machine. Each of the three supporting jaws floats on a center bearing. The three-armed central clamp has a fixed and an adjustable clamping screw on each arm and is fastened by a cen-

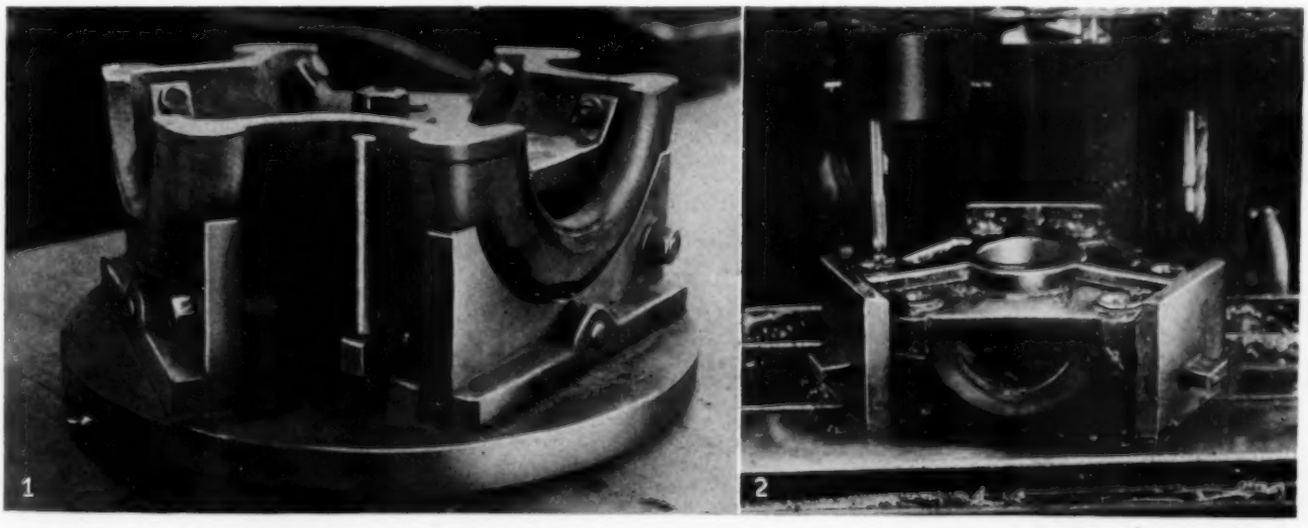
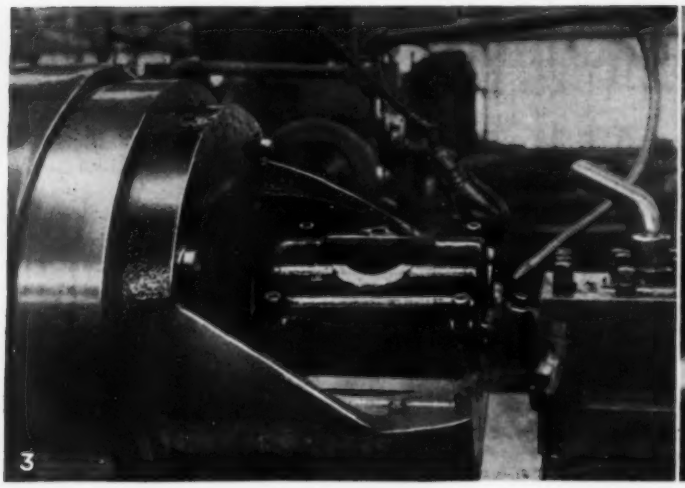


Fig. 1—Fixture in which hub barrel is held to have face ground on Blanchard machine. Fig. 2—Jig for drilling and reaming the holes for bolting hub barrel halves



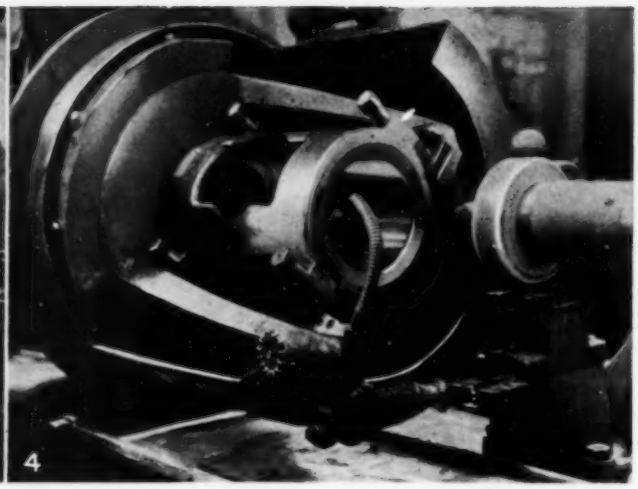


Fig. 3—How a two-bladed barrel is held for boring in turret lathe
Fig. 4—Grinding the same barrel in a special fixture on a Bryant machine

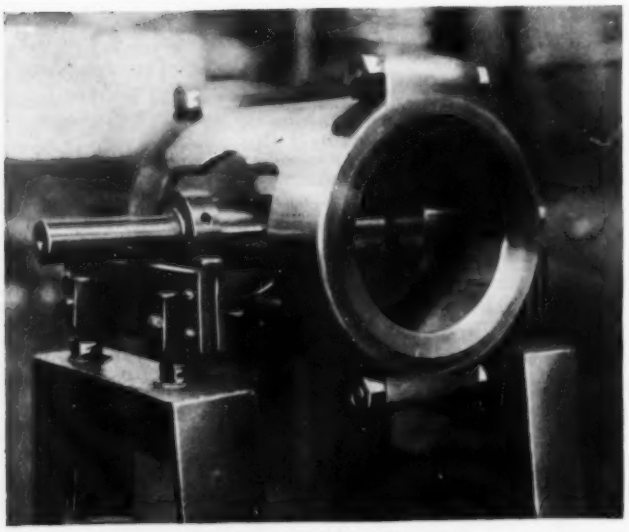


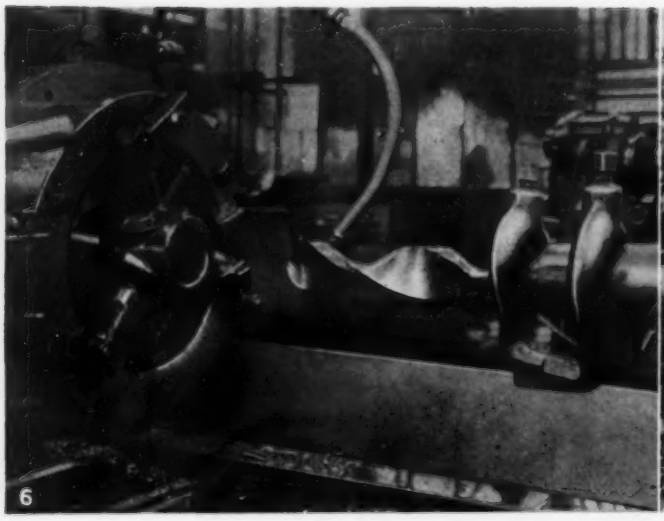
Fig. 5—Balancing barrel, using a special mandrel and parallel ways

tral bolt. The height gage helps to locate the forging in the fixture, care being taken to equalize the surface before grinding.

Locating from the ground surface, the barrel is fastened in the fixture Fig. 2, being supported by three clamps and positioned by the small cross-handled screws shown. Six holes for clamping bolts are drilled and reamed in this fixture.

A barrel for a two-bladed propeller is shown in Fig. 3. This has been surfaced, drilled and reamed in much the same way and bolted together before boring. It is held on an angle projection from the face plate and bored and faced by tools in the turret shown. A similar holding fixture is used in the grinding operation, Fig. 4, which shows how the barrel is held by special cap screws through the bolt holes already drilled and reamed. Inside the barrel can be seen the pilot bar which positions the barrel. This pilot fits the hole through which the spider projects to connect with the crankshaft of the engine. The tolerance on the intersection of the centerline axis is 0.002 in.

After these barrels are finished all over they are mounted on a mandrel that fits the pilot hole just referred to, and are carefully balanced on parallel ways as in Fig. 5. Accurate



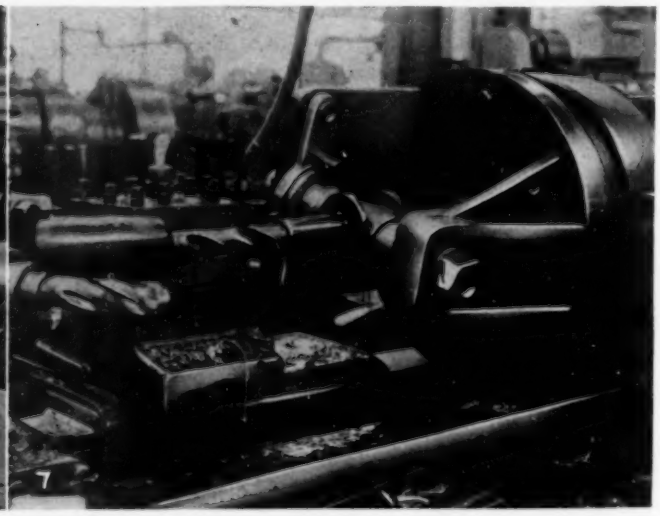
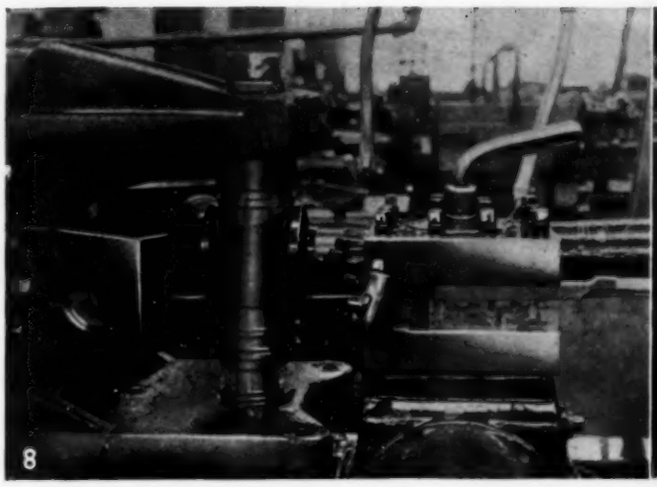


Fig. 6—Three-bladed spider held in special chuck for drilling. Fig. 7 —Spider for two-bladed propeller being drilled and turned in lathe



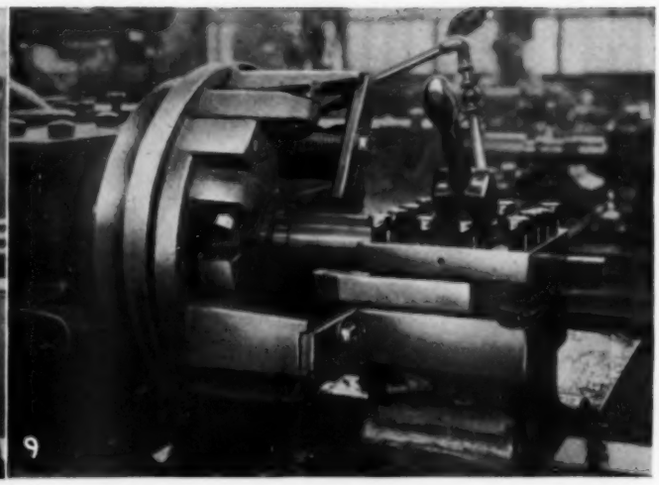


Fig. 8—This shows special chuck for holding either two or three-bladed spiders
Fig. 9—Expanding sleeve mandrel on which barrel is held for facing back end

balancing is necessary to insure steadiness and to prevent vibration as far as possible. This operation is indicative of the great care taken all along the line.

Machining the Spiders

The spiders, on which the propeller blades turn, are of chrome-nickel-molybdenum alloy, which Brinells from 375 to 425. This alloy cuts fairly well at 40 ft. per min. but is very hard to drill. The first drilling operation is seen in Fig. 6, this being the initial operation on the three-armed spider. The other spider operations happen to show two-arm spider forgings. These are drilled through both axes, the crankshaft hole being used for centering and holding while the propeller arms are drilled and turned. One of the propeller arms is being drilled in Fig. 7.

The taper is being turned on the arms in Fig. 8. Both Figs. 7 and 8 show how the spider is held and turned. The double arm against the wide angle plate in Fig. 7 is used in indexing the spider for drilling the opposite arm. The fixture in Fig. 8 is also used for a three-armed spider, the angular side arms supporting the arms away from the tools. The three index holes in the lower plate index the spider for the three

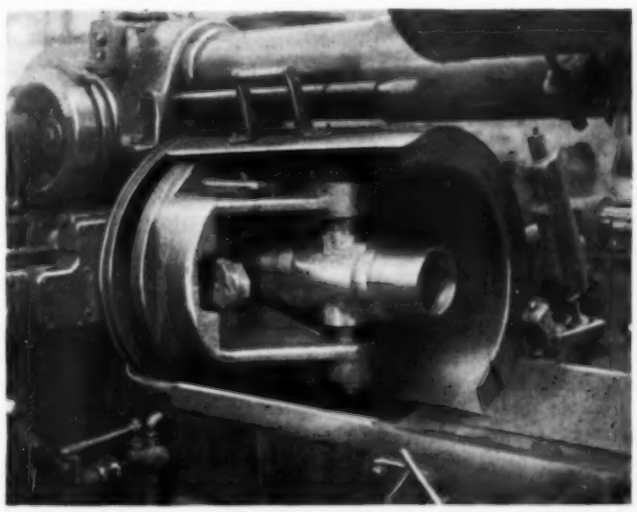
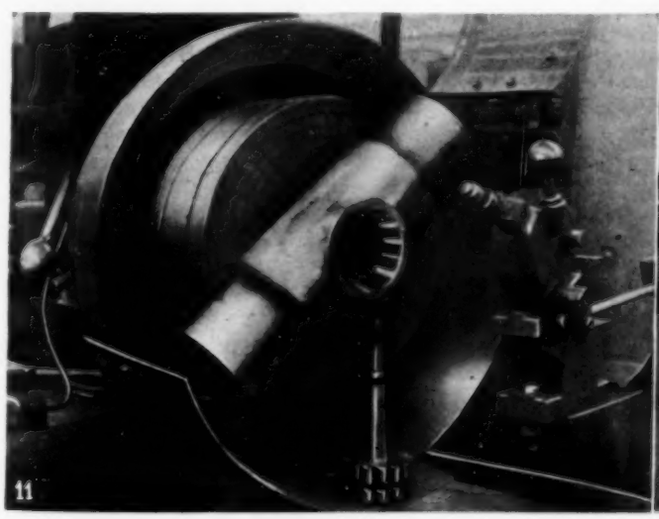


Fig. 10—Grinding fixture that handles hubs for two and three-bladed propellers



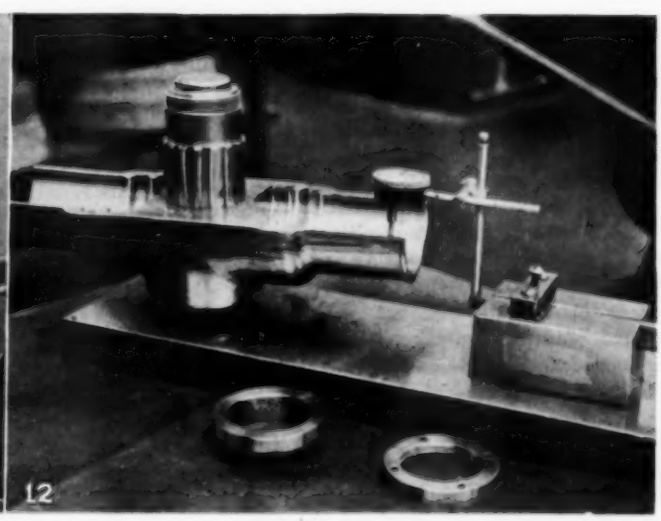


Fig. 11—Magnetic chuck on swiveling head for grinding taper for crankshaft
Fig. 12—Checking the squareness of the bore and the mating surfaces of a hub

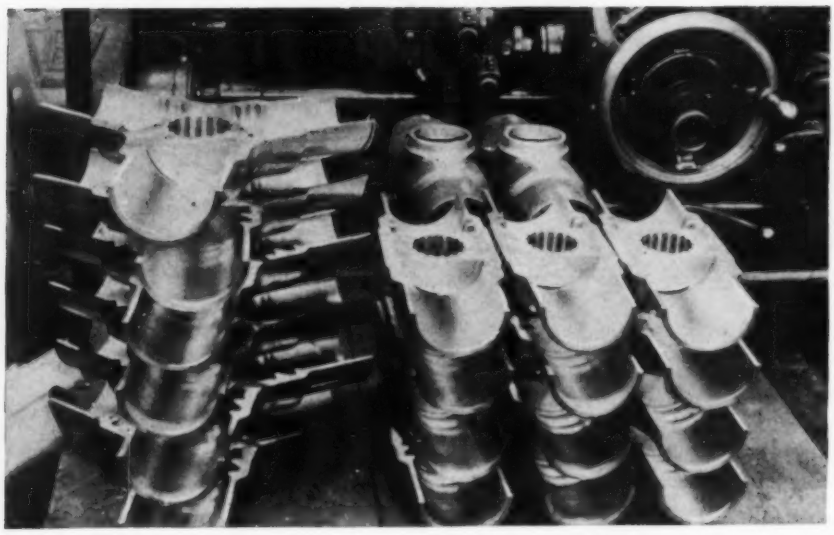


Fig. 13—Two stacks of two and three-bladed hubs, machined all over ready for grinding

positions. This operation turns the taper on the arms to receive the propeller blades. Fig. 9 shows an expanding mandrel to hold a spider while the back end in being faced. The block *A* has a hardened surface and is used for setting the tools to face the spider to the proper length. A standard bar is used between the block and the tool, to give the proper distance for facing.

The four illustrations that follow show propeller hubs for non-controllable propellers. The first, Fig. 10, shows a grinding fixture that handles both the two- and three-blade hubs while the end holes are ground. The taper seats at the outer end are first ground, after which the main bore is ground. The intersection of the center lines of the lengthwise and cross bores are held within 0.002 in. in 12 in. During the grinding operation the cover is pulled down over the work.

In Fig. 11 the taper on the crankshaft or splined bore is being ground on a machine with a swiveling head. The hub is held on the magnetic chuck being located in correct position by the setting plug in front of the hole. This plug fits the splined hole and the work is centered by the projecting end. The concentricity of the taper spline axis is held to 0.001 in. tolerance as any error here is multiplied at the end of the propeller blade and seriously affects the proper "tracking" of the blades.

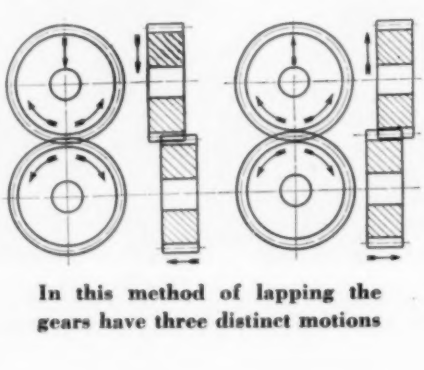
One of the inspections of such a hub is shown in Fig. 12. The splined hole is mounted on a shaft that represents the end of the engine crankshaft resting on a conical collar at the base. By swinging the half hub end for end, any variation in alignment of the two bores can be checked by the dial indicator shown. The other half of the spider can easily be put in place and held by the cone and nut shown. Readings can be taken in the bore when this is done. Fig. 13 shows two stacks of half hubs, both two- and three-arm being represented. These are chrome-vanadium steel and are completely finished, inside and out. They Brinell at 275 to 315.

Gear Tooth Finishing Discussion

L. C. MARBURG

Allow me to add to the very interesting articles by Fred H. Colvin on gear-tooth finishing (*AM*—Vol. 77, pages 357 and 407). Among the recent gear lapping machines is one which generates a uniform lapping action all over the tooth profile. This machine dispenses with laps, all the spindles being used for gears to be lapped.

This machine has an interesting combination of three motions. The gears are rotated in mesh at low speed as compared with running-in, and in contrast to the other motions. The motion is reversed as indicated in the illustration, to lap both sides of the tooth. The advantage of separately lapping both tooth flanks lies in concentrating the lapping action on one side of the teeth with gears that turn in one direction only.



In this method of lapping the gears have three distinct motions

The lapping action is secured by two oscillating movements that are coupled with each other. They consist of a rapid axial reciprocation of one of the mating gears while the other gear is oscillated rapidly in a radial direction so that the center distance between the two gears to be lapped is constantly changing as shown. The directions of both movements are at right angles to each other. The frequency of the axial motion is lower than that of the radial motion, the ratio being adjustable.

The oscillations can be equal or different in phase; i.e., when one movement has reached its end position the other one may or may not be in its end position as desired. The amplitude of both reciprocating motions can be varied. Due to the coupling of frequency and phase of both movements the tooth flanks in contact describe curves or parts of curves of widely different shapes, according to the selected frequency and stroke of each motion. In this manner the machine produces a lapping action similar to that secured by hand in the final finish of high class surfaces in manufacturing slip gages, gage-blocks and the like.

These rapid semi-circular movements which the tooth flanks describe upon one another, are the main characteristic of this method. They are independent of the particular zone of the flanks which are in contact, and since the rotary speed of the gears is low, the lapping effect is uniform over the whole profile. The zone about the pitch circle is subject to the same lapping effect as is the base or top of the tooth. By selecting the proper speeds and amplitudes of the reciprocating motions together with the best rotary speed, it is possible to concentrate the lapping action on predetermined zones and to adapte it to the particular profile to be lapped.

Special Thread Forms and Their Uses—*Correction*

Paragraph 3 (*AM*—Vol. 77, page 650) should read as follows:

The throat length of a chaser for a 60-deg. form of thread in National Coarse or National Fine Threads should be such as to permit the use of no less than a 20-deg. throat angle. The width of the undercut can be established by multiplying the thread depth by the cotangent of 20 deg.

NEMA Code Works Well in Production

Many things have come up in shops working under the NEMA code that will be enlightening to managers of other kinds of plants. Loss of skill by men out of work for a year or more is one thing turned up by a study of plants governed by this code

THANKS largely to their long experience in cooperation under the direction of their trade association, members of the National Electrical Manufacturers Association secured Presidential approval and started operating under their NRA code well ahead of the procession. In its basic features of providing uniform hours, wages and working conditions the code appears to be giving satisfaction. There have been a few flare-ups but on the whole employees have accepted with equanimity the changes brought about by the code.

The NEMA code was approved on August 4 after hearings conducted before Deputy Administrator Malcolm Muir. The maximum hours provided for are 36 in the shop, 40 in the office. Minimum wage rates are 40 cents per hour in the shop unless the rate paid July 15, 1929, was less, in which case that rate governs, provided it is not less than 32 cents. Learners get 80 per cent of the minimum. Office workers must be paid at least $15 per week.

Fair practice provisions of this code were discussed briefly in the introductory article in this series (*AM*—Vol. 77, page 709). In what follows no consideration will be given to this phase of code administration. The interviews on which this article is based were with operating officials, and the discussion covered the experience with adjusting to different hours and rates of pay.

Adjusting Hours

All sorts of things happened when weekly hours were adjusted to 36. Most of the shops visited went onto a day consisting of seven or seven and a fraction hours to make up the specified 36. One shop is now operating four days at 7 hours, and the remaining day at 8 hours. Other have split the odd hour into fractions. In no case examined by the investigators is any work being done on Saturdays, in the shop. On the other hand many plant offices have had to be kept open on Saturday mornings to take care of emergency requests for service.

Later Starts

Hours of starting and quitting have been revised either arbitrarily or to suit the convenience of employees. In one Eastern shop where many of the employees commute by train it was found that by changing the starting time 12 minutes the majority could reach the plant a few minutes before starting time instead of arriving so close to the limit that a mad rush characterized the beginning of every day. In a Mid-Western shop where the hours had been from 7 a.m. to 3:30 p.m. with a half hour for lunch the choice between taking an hour off the morning or afternoon period was put to a vote. Somewhat to the surprise of the executives who had expected a preponderance in favor of an extra hour off in the afternoon, the vote was almost unanimous for a work day running from 8 a.m. to 3:30 p.m. Investigation showed that many of the men had been getting up before 6 a.m. to drive or ride to work from the opposite side of the city. They much preferred an extra hour of sleep to an extra hour in the afternoon.

Generally speaking, the big corporations affected by the NEMA code have not attempted to standardize starting and quitting hours for their various plants. Because of the variation in local conditions production heads have concluded to leave the decision to the respective plant managers. In the major plant of one of the big companies the old hours were 7 to 11:30 a.m., 12:15 to 4:30 p.m., with a Saturday shift from 7 to 11:15 a.m. The new hours are 8 to 11:30 a.m., 12:18 to 4 p.m., for the first shift; 4 to 7:30 p.m., 8 to 11:42 p.m., for the second shift; midnight to 3:30 a.m., 4 to 7:42 a.m. for the third shift. On continuous-operation processes four six-hour shifts are worked. They start respectively at 7 a.m., 1 p.m., 7 p.m. and 1 a.m. Female employees, who work on the day shift only, stop work 12 minutes earlier than the men to avoid congestion at exits and in transportation facilities.

In almost every instance observed, where processes had been put on a four-shift, six-hour basis, there was an increase in output per worker. One manager reported as much as 20 per cent, which was a good deal of a surprise to the management. The reason seems to have been that the process involved physical effort arduous enough to cause a slowing down after the fifth hour.

Code Adds Men

Code operation in the electrical industry has added many men to the payroll. Some of the smaller plants have more than doubled their number of employees. The larger ones list additions in thousands. And there are all sorts of ratios of increase from zero up, depending on how busy a plant was before the code took effect, and also on how orders have been coming in since.

Wage rates have been increased in every plant visited. In some plants the increase was 10 per cent, in others 15. Some have gone back to the 1929 scale. In no case has there been a decrease.

When it comes to weekly earnings the situation is quite different. In those plants which were operating at less than the 36 hours specified in the code there have been more than a few instances of increases in the weekly pay envelope. These increases have occurred in the larger rather than the smaller plants. On the other hand, with few exceptions,

wherever there have been serious reductions in the number of hours worked there has been a decrease in the weekly pay. Generally speaking, the increase in rate has not been enough to offset the decrease in hours. And where good men have been accustomed to earn penalty rates on overtime emergency jobs where their skill made them valuable the drop has been even greater because such work has been far less frequent under code operation.

The natural result of such decreases has been a readily understandable resentment on the part of the men concerned. It has been largely responsible for the few strikes that have been called. Here is a case in point. Two different products are made in a certain large shop. One is electrical and the men engaged in making it went on a 36-hour week as soon as the NEMA code took effect. The other product is being made under a PRA calling for 40 hours. Quite unable to understand why they should have 4 hours less work a week than the men under the PRA, the NEMA code group staged an entirely spontaneous strike without benefit of outside organizers. Communist and less radical organizers filtered in as soon as news of the strike got out but made little headway. These strikers were not interested in principles. They wanted that extra four hours of work and pay.

In a nearby plant a rather unusual situation developed. The plant is a small one and the toolmakers have been with the company so long that they are practically part of the family. They had been working 52 hours at a rate only a little less than the 1929 rate. The code cut them to 36 hours and even a generous rate increase did not begin to make up the difference in weekly earnings. They are still on the job but they are ready to strike for their old hours if the president of the company will say the word. Try to match that for an anomalous situation in strike history!

Craft Consciousness

The attitude of all the men in this same plant is worthy of remark. The employees are divided into three groups, occupationally. The lowest group are interested only in a job and the money they get out of it. The next group won't mix with the first one, and the third group looks down on the other two. Attempts to unionize this plant have got exactly nowhere because of this class feeling and because of the belong-to-the-family attitude mentioned in a previous paragraph. Advocates of vertical unions in industry would do well to have this point in mind.

A somewhat similar situation as regards reduction in weekly pay because of shorter hours came up in a plant making small electrical devices. In this case the works manager called in the whole department concerned, frankly admitted the injustice to this particular group, explained why it was not possible to take up all the slack by a rate increase and put it up to the men that such inequalities were unavoidable in so drastic a recovery project as NIRA. He explained further that the company was making even greater sacrifices and stated his belief that both the company and the men would profit in the long run by accepting the immediate loss and gambling to get it back through increase in volume that would follow recovery. The men were still disgruntled but they agree that the sporting thing to do was to pay their share of the recovery bill this way and hope to get it back later.

Morale and Efficiency

It is hard to say what has been the effect of the NRA code on morale and individual efficiency in the electrical industry. A few of the managers interviewed reported improvement in both, others said they could see no appreciable difference. In both cases the effect of the NEMA code is probably inextricably mixed up with the effect of increased or decreased orders entirely independent of NRA.

One of the disturbing developments that has accompanied operation under this code is the loss of skill by men who have been out of employment for a year or more. Several plants in the Middle West have had serious trouble on this score, production costs having risen appreciably on acount of it. The code, of course, can hardly be blamed for this situation. It is mentioned here because it is one of the difficulties which have been encountered in adding to working forces instead of resorting to the old-fashioned overtime system.

If this loss of efficiency is going to be general throughout the metal trades, as plants resume more active operation—and there is no reason to believe that it will be confined to the electrical manufacturers—then something will have to be done about it. In a few companies the condition has been recognized and steps are being taken to put the victims of loss of skill through a short training course planned to enable them to recover it quickly. It may well be that we shall have to establish training departments and courses on the order of those developed during the war.

With all the machinists and toolmakers that have been laid off during the depression it seems almost silly to talk of training but we may as well recognize the fact that a certain proportion of these men have suffered so much from the hard times that they will have to be classed as unemployable. In one Eastern city this problem has become so acute that shop forces have had to be recruited from trade schools and technical high schools. Many of the unemployed journeymen and mechanics who were given a chance to work had developed so much resistance to new ideas and improved methods that they had to be replaced by the young technical graduates who had no such inhibitions. A book could be written on this phase of the recovery problem. Only the outline of the situation has been sketched in here to show its connection with the NEMA code.

Multi-shift operation has not as yet raised many difficulties. In most of the plants visited no expansion of this supervisory staff has been necessary. Foremen, under this code, can work 40 hours and the practice has been to have them arrange their time to overlap both shifts, if there are but two. Where forces have been reduced to the point where only the most experienced and expert workers have remained, supervision has been almost unnecessary where it has been possible to work these men into an extra shift. This procedure has not always been possible, of course. Where many green men have had to be recruited to make up the second shift, it has been necessary to provide the very best of supervisors. One instance was discovered where employment of a second shift is an impossibility because no seasoned foremen are available.

Two Checks

Practical methods of adjusting wages have been handled variously. One of the best encountered was in a large shop engaged on small and medium sized parts of great variety. Early in the summer a 15 per cent increase in wage rates was authorized. Since most of the men were on piece work the question of revising some thousands of piece rates came up. The final decision was to leave the rates as they were, thus avoiding heavy expense in the rate-setting department, and to add the 15 per cent to the weekly pay. As a matter of psychology it was decided to make this addition a separate check, thus emphasizing to the worker each week the benefit accruing from the increase. As the works manager put it, "It's amazing how soon a man forgets what his old pay was after he has had a raise. We remind him of it every week."

No trace was found, in this investigation, of serious difficulty or waste in changing over from one shift to another. In general, the operations performed in the plants visited were not of a nature

to make this a problem. Most of the operations are comparatively simple and short and the alternate shift can easily pick up where the other leaves off. Where the difficulty might have arisen it has been largely avoided by overlapping the foreman's time on the two shifts.

Equipment policies have not been affected by the NEMA code, so far. In other words almost no machinery has been purchased or is likely to be purchased until volume increases. A prominent factor here is lack of money, partly from the usual depression causes, partly from losses in closed banks. In several of the plants visited, however, the managers were quite ready to admit that they would have to move rather promptly, either in adding to equipment or in modernizing antiquated lines, if any appreciable rise in demand for their product occurred.

On the whole the experience of the industry with parts of the NEMA code affecting productive operations has been rather favorable than otherwise. Some sections of it might be modified to advantage but the basic principles are evidently workable.

Mechanical Engineers Discuss Manufacture, Design and Economics

WELL OVER a hundred papers, of interest varied enough to suit any taste, were presented during the annual meeting of the American Society of Mechanical Engineers at the Society headquarters in New York. In addition, business meetings, committee meetings, special addresses, symposiums, lunches, dinners and recreational events rounded out the week of December 4.

A high point of the manufacturing part of the program was the symposim on milling versus planing, held on December 5, with Joseph W. Roe, professor of industrial engineering, New York University, presiding. A. C. Danekind, assistant to manager, General Electric Company opened the discussion. Mr. Danekind pointed out the trend from planing to milling which became evident in 1916 and some of the reasons for it including the greater demand for high production by automobile manufacturers.

However, as Mr. Danekind showed, planing is still an important factor in general machine shop practice today, and careful cost analysis frequently indicates that it is more economical than milling, especially in the construction of turbines where single castings of large size and peculiar shape must be machined. Shapes or parts well adopted to planing are those with flat surfaces where the cutting tool is engaged in the work at least 75 per cent of the cutting stroke. Milling is usually more economical on flat surfaces located at intervals, such as bosses, pads, etc. Other important considerations are the amount of stock to be used, kind of material, tool and fixture costs and maintenance, and set-up time.

R. E. W. Harrison, consulting engineer, in stating the case for milling, quoted the *American Machinist* 1930 of Inventory of Metal-Working Equipment. He remarked that the survey showed 50 per cent of the milling machines installed since 1920, against a figure of 30 per cent for planers, and drew the conclusion that the newer industries had adopted milling rather than planing. He said that, broadly speaking, the milling machine was more economical on small work and on many kinds of medium work. In summarizing his analysis, Mr. Harrison stated that he believed the trend toward milling would continue because of the reduction in cost it afforded. Defending the planer, F. E. Cardullo, chief engineer, G. A. Gray Company, pointed out that the planer is a cheaper tool than the milling machine when both are required to handle work of the same size. He said that planers are more versatile than milling machines although the latter may be often used to advantage when a great number of similar pieces are required. Planer cutting tools are cheap and easy to make. Mr. Cardullo also noted that planed work is more accurate and flat surfaces produced by planing wear better and last longer. On larger work, repair and jobbing work in shops where the production of identical pieces is limited, and on accurate work and in the toolroom, the planer is usually economically superior. In the purchase of a new tool, Mr. Cardullo suggested a new type of machine, the milling planer, should be considered.

In a paper "The Problem of Quenching Media for the Hardening of Steels," Howard Scott, Westinghouse Research Laboratory, stated that for alloy steel the quenching medium actually selected must afford a compromise between the economy of low alloy content and the penalties of distortion. The best compromise appears to be obtained in media which provide a high cooling rate within the steel over the temperature range 600 to 500 C., together with a low cooling rate below 400 C. This variation of cooling rate reduces distortion considerably and minimizes development of residual stresses which are the cause of quenching cracks.

Mr. Scott continued that it is essential to recognize that the cooling in a liquid of a metal surface from a red heat to room temperature usually progresses in three well-defined stages. During the first stage, vapor cooling, a continuous film of vapor incloses the metal.

The second stage of surface cooling is the dominant one in the hardening of steel. Cooling powers of liquid when cooling by vapor liquid convection differ considerably from one another. Water appears to be as effective as any liquid with concentrated sulphuric acid a close rival. Oils are less active than water. Low viscosity oils are superior to high in this regard. Cooling in the third stage is relatively slow for all liquids. The change in cooling rate from the second to the third stage is particularly large in oils and is a valuable characteristic. It is enhanced by raising the temperature of the oil without sacrificing of cooling power at high temperature.

Albert Kingsbury, president, Kingsbury Machine Works, in a paper, "Heat Effects in Lubricating Oil," treats of the internal heating of the film in a steady state of shear as determined by the relative speed of the surfaces, by their respective temperatures and by the thermal conductivity and the viscosity of oil as related to temperature, without consideration of pressure gradients nor of

the influence of a supply of cool oil. Mr. Kingsbury developed the series of equations and shows their application by solving a particular problem graphically.

Cutting Fluids Tested

Cutting fluids are treated in a paper, "The Performance of Cutting Fluids when Sawing Metals," prepared by O. W. Boston, professor, and C. E. Kraus, instructor, College of Engineering, University of Michigan. Two series of tests, conducted on a Peerless high-speed, 9-in. hacksaw, are presented. The first was to determine the influence of four typical cutting fluids on the wear of the teeth of a tungsten steel hacksaw blade, and the second, to determine the influence on cutting time of eleven cutting fluids when sawing each of eight different materials with high-speed steel blades. It was found that the sulphurized oils were the best because of the shorter sawing times and the least wear on the saw blades. The 1 to 50 emulsion was found to be better than the straight mineral or mineral lard oil.

"Bending of Circular Plates with Large Deflection" was the subject of a paper by Stewart Way, Westinghouse Research Laboratory. The elementary theory of the bending of plates ignores the membrane stresses in the middle surface, which assumes importance in the case of large deflection. Mr. Way shows in his paper that, when deflection of a circular plate with a uniform load and a clamped edge is 1.2 times the thickness, the error in the elementary theory is almost 100 per cent. For thin plates, such large deflections may be accompanied by reasonably low stresses, so it is desirable for the designer to have some data at hand on the stresses and deflections in the plates with large deflections. In his paper, Mr. Way develops this data.

"Appearance and Design," which was originally scheduled to be given by Joseph Sinel, was discussed instead by Walter D. Teague. Mr. Teague points out the importance of appearance in creating buying favor and the necessity of combining artistic effects with functional devices. In combining the designing talent of the engineer and the creative work of the artist, the division of labor has been extended. The artist supplements the engineer's functions but in no way usurps them.

Allan H. Mogensen, consulting editor, *Factory Management and Maintenance*, discussed the question, "Has the Machine Designer Neglected Motion Study?" This neglect, according to Mr. Mogensen is caused by a lack of realization of the significance and importance of motion economy, and second, by a lack of understanding of the principles of motion economy. Motion-mindedness comes only through the ability to visualize the motions that are necessary to perform each step in an operation and to recognize which are and which are not good motion practice. Mr. Mogensen stated that few people realize how little of the time even the best equipment actually operates during the day. This, he said, can be corrected by the motion-minded machine designer in the reduction of set-up time.

In "Locomotive Counter-Balancing," L. H. Fry, railway engineer, Edgewater Steel Company, offers a method for computing and analyzing the counterbalance system of a locomotive. As a result of a straight-forward simple series of computation, a clear and exact picture is obtained, showing the resultant forces set up by the rotating and reciprocating parts and the counterbalance in any given locomotive.

"The Development of Light-Weight High-Speed Passenger Train" was presented by E. E. Adams, vice-president, Pullman, Inc. Mr. Adams described the development of the new Union Pacific railway train which was based largely on automotive and aircraft design. This equipment is designed for maximum speed of 110 miles per hr. with a sustained speed on straight and level track of 90 miles per hr. A train of three cars will weigh not over 80 tons which is the present weight of one Pullman sleeping car. In order to refine the streamline design, models were made of this train varying somewhat the shape of the ends, these models being placed in a wind tunnel in order to arrive finally at the best shape to give minimum air resistance. To get the full benefits of streamlining, the windows of shadowproof glass are placed practically flush with the outside of the car, vestibules between cars are covered to continue the smooth side, and all such devices, as headlights, tail lights, whistles and bells, are recessed into the car body.

Railway Journal Lubrication

"Actual Service Testing of Journal Lubrication" by Robert Job, vice-president, Milton Hersey Company, Ltd., gives the properties of several year-round oils which have been in practical service on an extensive scale in the Canadian National Railways. The teaching of practical service trials of year-round car oil has been that in order to be satisfactory under northern summer conditions a viscosity of at least 50 sec. Saybolt universal at 210 F. is necessary. On the other hand, to meet winter conditions, the oil should remain fluid, or nearly so, even when chilled to a temperature 30 deg. F. below zero.

A bearing which, generally speaking, does not develop oil film whirl was described by B. L. Newkirk and L. P. Grobel, Research Laboratory, General Electric Company, in a paper "Oil Film Whirl—a Non-Whirling Bearing." This bearing has grooves, which utilize the pumping effect of the rotating journal to built up oil pressure in the top of the bearing. In the experimental apparatus 2-in. journals were used and were run 30,000 r.p.m. or higher.

Stress Concentration Discussed

Because of the importance in machine design of tension or compression members having holes and notches, the problem of stress concentration produced by such discontinuity is of practical interest. The investigation reported in a paper by A. M. Wahl and R. Beeuwkes, Westinghouse Research Laboratory, is concerned primarily with the case of a bar in tension having either a centrally located hole or two symmetrically located semi-circular notches. The authors used the photoelastic fringe method, which consists essentially of making bakelite specimens, having holes or notches of the correct size, loading these in the loading frame of a photo elastic apparatus, passing monochromatic polarized light through the specimen and taking photographs of the black and white fringes. Empirical equations were derived for calculating the stress concentration factor on the basis of the test results.

In a paper, "Transverse Tests," James McKenzie, metallurgist, American Cast Iron Pipe Company, brought out the empirical nature of the results of the transverse tests and showed the general relationship between the test results and test conditions. These relationships furnished the information necessary for the use of transverse test results in the designing of cast iron members such as beams, hooks, arches, rings and long columns where the loading is essentially transverse. The load deflection curve is shown to be an excellent index of strength, stiffness, shock resistance, machinability, stamping capacity and the ratio of plastic to elastic deformation.

Depth of cold working increases more rapidly with increase in speed than with increase in depth of cut, according to L. Thomassen and E. M. McCutcheon, University of Michigan, who discussed this subject in the paper "Use of X-Ray on Depth of Cold Work by Machining." A linear connection was found between depth of cold working in turning as a function of the cutting force. An increase in depth of cold work of over 300 per cent was found on using a dull cutter instead of a sharp one in the milling experiment. According to the results ob-

tained this depth of cold work would indicate a great force expended on cutting. Increase in speed of milling from 154 to 342 r.p.m. did not increase the depth of work appreciably.

A Test for Bearing Metals

In "Investigating the Importance of Bearing Metals," J. R. Connelly, instructor in mechanical engineering, Lehigh University, described a new test, using a block of bearing metal with one side machined to a plain surface and a cylinder. This block is held by a constant force tangent to the cylinder. As the cylinder rotates in a bath of lubricant a depression is worn in the bearing metal. The projected area and the total volume worn away vary during the test. The test is run until there is no measurable increase in the depth.

To derive general expressions for stress in terms of loads upon the springs the diameter of the wire, the pitch angle of the helix and the radius of the helix cylinder in terms that an engineer can understand, was the object of a paper by H. C. Perkins, assistant professor of mechanical engineering, Cornell University, entitled "Stress in a Helical Spring of Circular Wire." The results of greatest general interest are the formulas for maximum fiber stress and sheering stress upon a cross section.

Among the papers on economics, Paul E. Cherrington, business consultant, contributed "Problems of Industrial Recovery. The Market and the Means of Reaching It." During his remarks on this subject, Mr. Cherrington stated that with price competition hamstrung, with chiseling temporarily suspended and quality competition hampered by higher labor costs and shorter hours, there is still left to American business men one conspicuous chance for acquiring leadership. This lies in the opportunity for creative invention in distributing methods—a more accurate forecasting of consumer demands and less obvious ways of supplying to the public what it wants.

A. W. Benoit, Charles T. Main, Inc., spoke on "Depreciation of Textile Machinery." Mr. Benoit pointed out that depreciation is a composite quantity made up of losses due to age, wear and tear, and obsolescence. Many textile firms, operating over long periods of years, have not made proper provision for the replacement of wornout machinery by the setting aside of adequate reserves as indicated by the annual amount of depreciation of textile machinery. To insure continuity in business, to preserve the original investment in textile machinery and to provide for replacements, reserves equal to the cumulative depreciation should be available.

In his paper "Industrial and Public Utility Plant Cooperation" H. D. Harkins, power design engineer, E. I. duPont de Nemours & Company, criticized the sales efforts of public utilities, which are directed toward the prevention of industrial plant generation, as unfair competition and unsound economics. Mr. Harkins stated that modern technical developments in higher steam presses and mercury vapor cycles make available more and more surplus electrical energy from the industrial heat flow, and this technical development favors the generation of electricity in connection with industrial processes.

Among the committee reports, those of special interest to the metal working field were the progress report in machine shop practice and the progress report of the special subcommittee on metal cutting data. The metal cutting report as presented by Robert C. Deale is abstracted on page 782 of this number.

The machine shop practice report presented by R. E. W. Harrison, secretary, points out the influence of NRA on the manufacture of machinery and also specifically outlines new developments in precision grinding in external broaching and in foundry practice.

Mechanical Aids to Hot Galvanizing—*Discussion*

A. EYLES
Manchester, England

To insure proper galvanizing, it is essential that the molten zinc really amalgamate in proper homogeneity with the surface of the metal to which it is applied. The chief requirements for this molten coating of zinc on iron or steel as a protection against rust and corrosion are: (1) that the coating be absolutely adherent, ductile, and not likely to flake or peel off; (2) that it be not porous, so that the metal is entirely protected from atmospheric corrosion. Such perfection of results in hot galvanizing can only be attained where the tools, plant, materials, and methods employed are up-to-date.

Hot galvanizing has nothing galvanic about the process at all, as might be inferred from its name. Probably the process was called "galvanizing" because zinc and iron form together a galvanic couple, of which zinc is the more electropositive. The zinc coating is therefore attacked first, and thus preserves the iron or steel from oxidation; nevertheless, the word is a misnomer when applied to iron or steel.

Although the actual procedure differs considerably in different hot galvanizing plants, the general principles underlying the process are the same. A typical hot galvanizing plant consists of a tank (usually called the kettle) in which the metal is melted, water cleaning and pickling tanks, drying ovens to take work before it is dipped, suitable racks, hooks, tongs, ladles, dross spoons or skimmers, flux guards and pyrometers. In some hot galvanizing departments, it has been found advisable to install special machinery which centrifugally or by rotary motion throws off superfluous zinc as the articles come from the bath.

Galvanizing baths at one time were made of wrought iron, but this has largely been superseded by steel. Research having established that the life of a galvanizing bath is approximately proportional to the purity of metal from which it is fabricated, the use of a very pure form of iron (such as "Armco" iron) has been tried with success. Some baths are of riveted construction, but the modern welded bath is better. The dimensions of the galvanizing bath depend naturally upon the size of the articles to be galvanized; 12 ft. by 5 ft. by 5 ft. is a useful size.

Zinc used for hot galvanizing should contain not over 1.60 per cent of lead and 0.08 per cent of iron. In certain hot galvanizing works, there is a general opinion that the presence of lead in zinc is favorable to the development of spangles on galvanized sheet. In fact, zinc which contains over 1 per cent of lead is preferred by the British sheet galvanizing industry. A small quantity of cadmium is sometimes put in the zinc bath. This metal, however, tends to produce very fine and small spangles, which does not add to the appearance and bright finish of the galvanized article. Small quantities of aluminum and tin, when added to the zinc bath, tend to give the zinc coating a bright metallic finish and are desirable in developing good characteristic spangles. Antimony, even in small quantities, makes a zinc coating dull and brittle.

I strongly indorse the statement by Wallace G. Imhoff (*AM*, Vol. 76, page 616) that it is not possible to solder articles successfully with zinc as many believe. The melting point of ordinary solder "half and half" (50 per cent tin and 50 per cent lead) is about 370 deg. F., whereas the melting point of zinc is about 780 deg. F. Hence it is not practicable to make the zinc flow satisfactorily in open seams.

Speed is no great asset in hot galvanizing for the reason that the iron or steel article should be kept beneath the molten zinc surface until it becomes equally as hot as the zinc. If this method of procedure is not carried out, an unnecessary amount of zinc will adhere to the article.

Can the Cutting of Metals Be Made a Science?

ROBERT C. DEALE
Secretary, A. S. M. E. Subcommittee on Metal-Cutting Data

A YEAR AGO, the Special Research Committee of the American Society of Mechanical Engineers on the Cutting of Metals appointed a subcommittee on metal-cutting data, to study the available records, to correlate the results obtained by various experimenters, to carry on such experimental work as proved to be necessary to fill in the gaps in existing knowledge, and finally, to publish in handbook form an authoritative set of data covering all operations in the cutting of metals. It is hoped to include information as to the relative value of the various tool steels, the best method of heat-treatment, the effect on the permissible cutting speed of the shape of the tool used, methods of tool grinding, information as to the method of calculating tool life giving minimum over-all cost for a given set of conditions, formulas giving the effect of tool size and shape, feed, depth of cut, and tool life under cut on the associated cutting speed for a given tool material, cutting a particular metal, and a series of tables, similar to Table I. These tables will give the cutting speeds, together with the horsepower required, when cutting a particular metal, under given conditions of tool material, heat-treatment, size and shape, with the depth of cut and feed.

Table I has been made up, using the best available information, but is intended rather to show the form in which it is proposed to publish information, so that it may be readily used, than to give actual metal-cutting data. It will probably be desirable to adopt a standard tool life under cut for the tables, with a supplemental table of multiplying constants for changing these speeds when some other tool life is found to be desirable. With such data available, it is believed that it should be possible to predict just what cutting speed should be used under a given set of conditions, with a degree of precision sufficient for all practical work.

Before undertaking any definite work in the investigation of the data on the cutting of metals, the committee thought it advisable to determine the present relative importance of the various materials used as metal cutting tools. To provide this information, a questionnaire was sent out to a number of machine shops, carefully selected to provide, as far as possible, a cross-section of the metal-working industry of the country. The returns, as analyzed, showed a distribution between the various tool materials as follows:

Tool Material	*Approximate Percentage of Use*
Carbon tool steel	15
18-4-1 high-speed steel	65
14-4-2 high-speed steel	11
Cobalt high-speed steel	4
Stellite	3
Tungsten and tantalum carbide	2

While it is realized that the use of the newer tool materials will undoubtedly grow, it is believed that the data on high-speed steel tools would be of the greatest immediate value to the country as a whole. This is particularly true because the cutting abilities of the 18-4-1 and the 14-4-2 steels were found to be so close, when both were properly hardened, that one set of data could be used for both. To facilitate the preparation of data, it was decided to do no work on cutting with stellite and the carbides until after the work covering steel tools had been completed.

During the past year, available literature on the subject, together with a certain amount of unpublished data, has been carefully studied. It was soon found that the problems involved might be roughly divided into a small number of general heads, as follows:

1. Metallurgy of the tool used
2. Geometrical relations involving tool size and shape, and the size and proportion of the chip
3. Effect of the cutting speed on the tool life under cut
4. Machinability of the metal cut. This involves the speed at which a given material may be cut under fixed conditions of tool material, heat-treatment, size, and shape, feed, depth of cut, and tool life under cut
5. Effect of the use of coolants on the associated cutting speed under a given set of conditions.

While there is an extensive literature on the cutting of metals, our study has shown that a small part of this, probably not over 10 per cent, is sufficiently specific to be of any real value. There are little data in which the cutting speed is correlated with the tool life under cut and those other variables which must be considered if the data are to be of real value.

In regard to those questions involving the metallurgy of the tool, there would seem to be an opportunity for further investigation. In "On the Art of Cutting Metals,"[1] the metallurgical work of Taylor and White in connection with the discovery and development of high-speed steel and its treatment is rather fully covered. This covers a variety of steels previously on the market, as well as those developed as a result of Taylor's research, which settled upon a steel of the following composition as the best: carbon 0.68-0.70; tungsten 18.00; chromium 5.50-6.00; vanadium 0.30; manganese 0.07-0.15; silicon 0.04-0.05; phosphorous and sulphur as low as possible.

Effects of Alloying Elements

The Taylor-White investigation also included steels containing molybdenum as a substitute for tungsten, but which Taylor did not consider desirable. Work has continued recently on the effect of this element, particularly in several of the United States government arsenals, so that knowledge would be available as to the manufacture of molybdenum steels in case the supply of tungsten should be cut off by a war, or otherwise. Apparently it has proved possible to make reasonably satisfactory steels by substituting molybdenum for tungsten, but such steels apparently have little to recommend them when tungsten is readily obtainable, with the result that substantially all steels on the market in this country at the present time are tungsten steels.

French and Digges, in their work at the United States Bureau of Standards[2,3], have investigated the effect of cobalt, molybdenum, and tantalum additions on tool cutting efficiencies, as well as the effect of nickel, antimony, arsenic, copper, and tin. Kinzel has studied the effect of changes in vanadium content[4], although the cutting tests reported are

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Abstracted from a committee report presented at the A.S.M.E. Metal Cutting Session at Stevens Institute of Technology, Hoboken, N. J., December 7, 1933.

not extensive enough to warrant more than general conclusions.

While Taylor studied the effect of tungsten, chromium, carbon, silicon, manganese, phosphorous, and sulphur, the data given in "On the Act of Cutting Metals" is in such form that it is difficult to study the effect of a change in a single constituent. However, Edwards[5], in 1908, carried on a comprehensive set of experiments, in which the effect of changes in tungsten and chromium content can be isolated.

As present-day steels in general contain greater percentages of silicon, manganese, phosphorous, and sulphur than Taylor believed to be desirable, it would seem that a study of the effect on the cutting ability of a tool of the inclusion of varying proportions of these elements would be valuable. It is realized that steels containing higher proportions of these elements are cheaper to manufacture than similar steels in which these percentages are reduced. Only if the cutting efficiency of the tool should be thereby appreciably increased can we justify the manufacture of a steel having lower percentages of these substances, which may be considered as impurities.

The heat-treatment of high-speed steel has largely been treated as an art. There are so many variables concerned that most investigators seem to have felt that it was too difficult a task to control them all. Taylor was particularly handicapped in this respect, in that he did not even have a pyrometer which was reliable at the temperatures used. With his limitations in equipment, it is amazing that he was able to make the advances he did in the composition and treatment of high-speed steel tools.

Taylor, in his patent[6], and in the instructions to parties licensed to use the Taylor-White method for treating tools, was definite as to the preheating temperature, and gave both temperature and time for the second, or low heat-treatment. Although he was unable to state definitely in degrees the temperature for the high heat-treatment, or the time in minutes, he did indicate that the tool should be quickly transferred from the preheating furnace to the high-heat furnace and brought quickly up to a temperature near the melting point. He indicated that the nose of the tool should be protected from furnace gases which he accomplished by coating it with a powdered slag after preheating, thus forming a molten film when it was placed in the high-heat furnace. He also indicated that the soaking, or subjection of a tool to a high heat for too long a period was injurious.

Under Taylor's guidance, Hathaway conducted, about 1909, a series of experiments at the Tabor Manufacturing Company with a view to determine more exactly the high-heat temperature, means for its measurement, and the proper time that tools of various sizes or sections should be submitted to the high heat. These experiments resulted in the use of a pyrometer of the Fery type in conjunction with a test block of high-speed steel. While the resulting methods and tables were satisfactory from a practical standpoint and have been used

Turning—Dry

S.A.E. 1020, 0.15–0.25 Carbon, hot rolled steel; ultimate strength—62,000 lb. per sq. in., Elongation—31 per cent; Brinell—127; Rockwell hardness, B Scale—70; Shore scleroscope—23
Finishing tools to be given "drag" at least equal to feed.

½x¾ In. Standard Round Nose Tool, Nose Radius 1/16 In. 60-Minute Tool Life

Feed in Inches Per Rev.

Depth of Cut	0.005 Hp.	0.005 Speed	0.0075 Hp.	0.0075 Speed	0.012 Hp.	0.012 Speed	0.016 Hp.	0.016 Speed	0.024 Hp.	0.024 Speed	0.036 Hp.	0.036 Speed	0.050 Hp.	0.050 Speed	0.075 Hp.	0.075 Speed
Finishing Cuts																
0.005	0.37	946	0.47	844	0.62	746	0.74	696	0.81	626	1.41	564	1.74	519	2.28	471
0.010	0.68	804	0.72	705	0.96	622	1.18	575	1.52	517	1.99	464	2.53	426	3.43	387
0.015	0.75	717	0.95	635	1.27	560	1.50	516	2.01	462	2.59	417	3.33	383	4.35	345
Roughing Cuts																
0.0312	2.07	971	2.15	722	2.33	532	2.51	439	2.73	337	3.17	265	3.35	216	3.83	173
0.0625	3.37	772	3.49	563	3.81	417	4.07	345	4.37	263	4.62	200	5.05	164	5.57	127
0.093	4.50	682	4.73	511	5.02	365	5.17	298	5.56	228	5.91	179	6.41	139	7.05	108
0.125	5.48	613	5.82	464	6.05	328	6.35	268	6.75	203	7.22	154	7.66	124	8.25	96
0.1875	7.59	540	7.88	405	8.25	293	8.61	237	9.17	182	9.79	136	10.20	109	10.88	82
0.250	9.36	493	9.95	363	10.38	266	10.60	217	11.28	165	11.91	124	12.47	99	13.33	95
0.375	12.60	438	13.10	326	13.72	233	14.23	192	14.83	142	15.80	108	16.52	86	17.48	65

Width of Tool, Inches

Feed in Inches/Rev	1/8 Hp.	1/8 Speed	1/8 Hp.	1/8 Speed	1/4 Hp.	1/4 Speed	3/8 Hp.	3/8 Speed	1/2 Hp.	1/2 Speed	5/8 Hp.	5/8 Speed	3/4 Hp.	3/4 Speed	1 Hp.	1 Speed
Cut-Off																
0.002	2.01	932	2.86	630	3.03	433	3.91	407	....	...	....	...	....	...	....	...
0.004	2.19	522	3.01	363	3.37	265	4.34	253	....	...	....	...	....	...	....	...
0.006	2.24	364	3.09	260	3.61	200	4.63	190	....	...	....	...	....	...	....	...
0.008	2.32	281	3.35	211	3.87	163	5.00	156	....	...	....	...	....	...	....	...
0.010	2.40	229	3.43	157	3.95	138	5.12	134	....	...	....	...	....	...	....	
Forming Cuts																
0.001	....	...	1.48	595	2.73	511	3.89	468	5.01	439	6.08	418	7.18	403	9.22	378
0.002	....	...	2.21	486	3.97	418	5.67	383	7.29	360	8.87	343	10.38	329	13.35	309
0.003	....	...	2.71	425	4.86	366	6.96	336	8.96	316	10.90	301	12.71	289	16.31	271
0.004	....	...	3.22	388	5.77	335	8.16	307	10.51	290	12.67	275	14.91	265	19.03	248
0.005	....	...	3.65	362	6.43	313	9.23	288	11.71	270	14.21	257	16.63	247	21.35	232
0.006	....	...	4.05	342	7.03	298	10.15	272	13.00	257	15.70	244	18.42	235	23.70	221
0.007	....	...	4.45	326	7.60	285	11.36	264	14.29	245	17.33	234	20.30	225	25.95	211
0.008	....	...	4.80	313	8.12	272	12.00	247	15.52	234	18.70	223	21.80	214	27.90	201
0.009	....	...	5.12	301	8.70	263	12.50	238	16.05	226	19.50	216	22.70	207	29.10	195
0.010	....	...	5.45	292	9.15	254	13.12	229	17.00	219	20.55	209	24.00	201	30.55	188

by a limited number of concerns, they were not regarded as conclusive and were never published.

Probably the best available experiments extending the work of Taylor in regard to heat-treatment and its effect on cutting efficiency are those conducted by French, Strauss, and Digges, in their work at the United States Bureau of Standards. These experiments[7, 8], which include work on roughing and finishing lathe tools, with both 18-1-1 and 14-4-2 steels, and similar steels containing approximately 5 per cent cobalt, show cutting efficiencies increasing with the hardening temperature up to a maximum, which appears to be somewhat different for each general analysis of steel, and then falling, as the steel is overheated and incipient fusion occurs. This work has emphasized the importance of the time that the tool is held at the hardening temperature, but unfortunately it did little more with this important variable than to determine approximately the best time for the ¼x½ in. tool bits used in the experiments.

Since the time of this work, the importance of an inert furnace atmosphere has been recognized by Tour[9] and others, and furnaces have been put on the market which make it possible to hold this atmosphere at any desired analysis. It is believed that it is important to determine accurately the relation between size of tool, hardening time, furnace atmosphere, hardening temperature, and the cutting efficiency of the tool.

If it should prove practical to determine with some degree of accuracy the relations between cutting speed, size and shape of the tool, and the size and proportions of the chip removed, the labor and expense required to build up such tables of cutting data as are proposed will be greatly facilitated. The available literature is somewhat disappointing on this point. There are practically no published data on anywhere near a scientific basis, in which the relation between these variables has been determined for anything other than a single point paring tool. Even for such tools there is a relatively small amount of data available. Eliminating the work done in Germany, which has not been thoroughly studied as yet, the following represent the only really important sets of data:

Sources of Data

1. "On the Art of Cutting Metals"—In this classic paper, which Taylor presented to the A.S.M.E. as his presidential address, in 1906, there is a wealth of data. Not only are methods of experimentation well worked out, but there is much practical information available. It is not known exactly how the steels used by Taylor compare with present-day tools, so that there must be some experimental correlation before these data may be used directly. However, as will be seen further on, a comparison of available data would seem to indicate a superiority of the steel which Taylor designated as the best over the most widely used present-day steels. All data are given in the form of cutting speeds which may be used with tools of the size and contour there adopted as standard, for different depths of cut, and different feeds. Neither the data there given, nor the formulas which are there derived are suitable for tools having appreciably different sizes or contours.

Manchester Experiments

2. University of Manchester, Lathe Tools Committee—This work[10, 11], which was directed by Dempster Smith, covered many of the points which arise in the rough turning of steel and cast iron. Here, again, such data as have been presented are applicable only to the type of tools used in the experiments. It is believed that the conclusions as to the effect of nose radius and tool size are not of general enough application to be really valuable.

3. University of Sheffield—Professor Ripper[12] has carried on experiments, on a much smaller scale than those at the University of Manchester, which are open to the same objections. Some attempt was made to develop a general relation, but it is not believed to be basic in form.

4. United States Bureau of Standards —French and Digges[8, 13, 14, 15] have made no original contributions to geometrical considerations in the rough turning of steel. Their most important contribution to this phase of metal cutting is their work with light finishing cuts. Not only have they developed a satisfactory method of test on such types of cutting, but they also have shown the effect of depth of cut and feed. This again is for a tool of one fixed size and shape, with the cutting speed given in the form of curves with feed and the depth of cut as the other variables.

5. Sweden—E. A. Forsberg has carried out a number of experiments[16] on the rough turning of steel and cast iron. These are the only extensive experiments available, in which modern types of tool steels have been used in the form of practicable shop sized tools to cut both steel and cast iron. As in the case of the other work noted, all conclusions are given in the form of cutting speeds under definite conditions of tool size, shape, and contour, and of depth of cut and feed, and consequently are not applicable to tools having a different size or shape. Ragnar Woxen[17] has attempted to determine a general relation, largely on the basis of this work. He has gone further than have any of the previous workers in this field, but mathematical analysis indicates that he has not gone as far as is necessary to establish an accurate relation for all shapes of tools.

6. Barth—Carl. G. Barth[18], in a supplement to "On the Art of Cutting Metals," has analyzed the mathematics which he used in developing the cutting relations shown there, has simplified these formulas, and has shown the method of constructing slide rules for predetermining the cutting speed to be used under various conditions. He gives data for constructing lathe, planer, shaper, slotter, milling machine, and gear cutting slide rules and gives data on feeds and speeds for drilling. While none of these data give results which are applicable to other than the standard tools, it is believed that Mr. Barth must have some basis relation which he uses, as it is known that, in the course of his consulting work, he constructed slide rules for practically all machining operations.

Speed Measurements Vary

In addition to the variations noted above, it has been found that three different methods of measuring cutting speed have been adopted. Taylor measured speed on the uncut portion of the log, ahead of the tool. This method was also followed by Ripper. It is believed that this conforms to the practical shop method of measuring cutting speed as used in this country, particularly as it is the only speed which can be measured before starting a cut. All work done at the Bureau of Standards is based on the speed at the bottom of the cut.

In order to compare these results and to make it possible to determine the speed which should be used when other than a tool of standard shape is used, it is believed necessary to determine a general relation, which will take into consideration the shape of the tool nose as well as the depth of cut and feed. Taylor saw the desirability of having such a general relation.

The determination of such a general law is necessary as a base for building up such tables of data as the committee proposes, unless a tremendous amount of experimental cutting is done. A certain amount of work has been done to determine the possibility of determining such a law. Although only the previously mentioned experimental work was available, a tentative equation was derived which served to explain various experimental relations, such as those between the speed for a Taylor standard tool, and that to be used with the Taylor broad-nosed shafting tool, with a fair

degree of precision. With this equation, and with cutting speeds calculated on a uniform basis, it was found possible to reconcile experimental results which otherwise appeared to give very different values. The results obtained have been such as to justify a certain amount of optimism as to the possibilities, providing that a series of experiments are undertaken which would be designed to show the validity of such a relation.

Tool Life Exponent

There is much data as to the effect of cutting speed on tool life under cut when turning steel and cast iron, but unfortunately, individual results do not agree with each other, although there seems to be a general agreement that tool life varies with cutting speed according to the following law:

$$VT^n = \text{a constant}$$

in which:

V = Cutting speed

T = Tool life under cut

n = an exponent, which seems to vary with the material of the cutting tool, and the general type of metal cut. It possibly depends also on the type of cut.

There is a close correlation between the value 0.1252 of the exponent n, as determined from the data given in "On the Art of Cutting Metals," and the value 0.1255 of the same exponent, as determined from the original experimental data as secured from the work by French and Digges when these two sets of data are given the same mathematical treatment. Dempster Smith and Forsberg also report a similar value when cutting steel with high-speed steel tools. Ripper obtains a value of 0.083, although individual sets of his data show considerable variation. Boston[19] shows data to substantiate the conclusion that this value varies with nose radius, front cutting angle, rake, and possible depth of cut, between 0.076 and 0.111. French and Digges have determined a value of 0.100 when finish turning steel. Barth reports 0.083 when rough turning cast iron, Dempster Smith a value of 0.100, and Wallichs and Dabringhaus[20] 0.099 for the same conditions. There is obviously much work which must be done to reconcile these differences, if the relation is to be used with any degree of certainty. On the basis of the older work, omitting that by Professor Boston, it would seem that a value of 0.125 represented every case in which the tool fails by channeling on the top surface, eventually wearing such a large pit that it breaks through the cutting edge, while the value of 0.100 represented all cases in which the tool fails by wear on the front edge. This is as yet unproven, and falls down if the more complicated relation is found to hold.

In this connection, it is interesting to note the effect of the tool life under cut on the over-all cost of the part being machined. The author has investigated several typical jobs[21] and found that the most economical tool life is much shorter than is commonly believed. For ordinary engine lathe work, in which the average cut is relatively short, it was found that the lowest costs were secured with a tool life of approximately 30 minutes, although the tool cost under these conditions may be considerably higher.

There is little work which can be used as a basis of the specific machinability of the various metals. The data given in "On the Art of Cutting Metals" covers most of the carbon steels, while the Bureau of Standards have done such work with a number of the more common alloy steels. While some data is available as to cast iron, there is a question as to just how a given grade of iron may be recognized. There is absolutely nothing as to the modern alloy cast irons, and little or nothing available as to the various copper and aluminum alloys, which are being used extensively at the present. In addition, there are other materials such as monel metal and bakelite, concerning which nothing is available. It will probably be necessary to run separate tests on each metal, although it is hoped that these tests can take the form of a single point, the data from which can be expanded by some general relation.

Little data are available as to the effect of a coolant on the cutting speed at which a tool can operate. Taylor developed such a relation, which was checked by both the Manchester work, and that at the Bureau of Standards. It is not known whether one coolant has a greater effect on the cutting speed than another, as most of the work on the comparison of coolants has taken the form of tool pressure measurements.

Other Tools Need Study

While there is a certain amount of data available on simple turning tools, there is little covering the other operations. The manufacturers of some of the special cutting tools, such as drills and reamers, have published some data as to the speeds and feeds to be used. This data, however, is in such general form that it is little more than a general guide. Nothing is given as to the effect of cutting speed on tool life, or whether the speeds given should be changed if feeds are changed.

A careful study of existing data, coupled with such experimental work as is necessary to coordinate this older work, should make it possible to change the cutting of metals into a true science. The Subcommittee on Metal Cutting Data has been working on a program which it is hoped will lead to this end. It proposes to make a start on the experimental program immediately. Stevens Institute of Technology will make available the lathe and billet that is being used in the metal-cutting demonstration as part of the Taylor Anniversary Celebration.

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Cost Finding To Assure Profits—VIII

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Especially in large concerns, cost details cannot be given close analysis by chief executives. They must have a medium which will give a concise but complete picture of plant performance such as is afforded by the departmental profit and loss summary described below

ALTHOUGH it is practical to specify uniform cost-finding and control methods and to indicate their proper employment, it must be appreciated that the actual use that will be made of the methods will be determined by such diverse factors as the type of organization, the nature and size of the business, the capacity and responsibility of the executives, their personal habits of thinking and acting, and the requirements of the business.

The departmental profit and loss summary, Fig. 11, is the final summation record of general cost activity for a cost period. Primarily, it serves as a complete and coordinated periodic cost report for executive use. Secondarily, it serves as a final collection record of unit departmental costs and profits and losses and is the medium for journalizing charges from manufacturing expense to distribution expense and sundry accounts. For various accounts, it may also be used as visible proof of the accuracy of distribution between departments and accounts and of allocation to the proper account.

When no unusual variations occur, this report reveals that desirable condition and obviates the necessity for executive study of the more detailed records back of it. On the other hand, when results are out of line, this record, acting as a thermometer, reveals that fact and, furthermore, indicates which detail record should be examined in order to discover the cause of the variations.

The digests, which have been described in previous articles, present to the executive and sub-executive the cost activities by elements of cost for current control. The departmental analyses portray these same cost elements coordinated by departments for executive comparative use and for unit evaluation and revision by the cost department. The departmental profit and loss summary finally summarizes into a complete picture for executive perusal and action all manufacturing and distribution costs as well as profits or losses for a cost period.

The three steps are concise and deliberate, and each one accomplishes in the most direct fashion the necessary control revelations and accounting purposes.

In the comparatively small, and in many medium sized businesses, it is usually management's responsibility to administer practically all of the prescribed control functions. For such businesses the organization is seldom large enough to warrant the delegation of this responsibility to sub-executives. Although the sub-executives are kept currently informed of the cost activity under their supervision, management exercises the whip hand.

Let us see how intelligent use of the departmental profit and loss summary indicated to the management of a medium sized metal-working plant conditions, which when rectified, resulted in annual savings averaging some $68,000.

This concern's production by departments was rather seasonal, although its total activity fluctuated little. Nevertheless it was constantly in hot water cost-wise prior to the adoption of uniform cost methods embodying the modern control features which are being described. The varying demands required continual adjustment of the labor assignment. As the activity of a department fell off, the adjustment of labor to the new production activity lagged. Although wage incentives were used to some extent they failed to serve as an effective control of labor costs. While the activity was increasing, the amount of labor employed, both direct and indirect, was often excessive.

It was not unusual to find a decreasing activity in one department and an increasing activity in another occurring simultaneously. By the time the proper labor readjustment was worked out, a group of temporarily unemployed had been developed, while at the same time excess labor costs had been incurred, together with some unnecessary expense cost as well.

When proper cost-finding and control methods were finally installed these unwarranted labor and expense costs were immediately flashed to the management as they occurred. Knowing the condition, the management was in a position to require prompt adjustment of labor assignments within a department in keeping with varying activity and so maintain the anticipated unit costs.

Savings Through Cost Control

This particular business had an unusually large number of manufacturing departments and required the exercise of day-to-day control. For much of the material and practically all the labor, a daily control was maintained through the use of digests. The cumulative effect of this daily control was observed in the departmental profit and loss summary for the cost period. The summary not only brought to light the chronic cost excesses, but indicated the departments whose costs should be reviewed in detail for the cost period under consideration and those whose activity in the coming cost period would bear careful watching.

The annual excess variations over the anticipated costs had approximated $15,000 for material, $25,000 for expense and $35,000 for labor, or a total of about $75,000. They have been kept within $7,000 a year ever since uniform cost methods have been in use and positive control has been exercised.

In the larger businesses the responsibility of the initial and current control features, provided by the digests and departmental analyses, is usually delegated to the sub-executives and supervision. Management relies on the departmental profit and loss summary for general cost control. In this way management maintains its perspective of the

business as a whole as well as its sense of proportion between the distribution and manufacturing departments' activities.

The chief executive of one large fabricating company told me recently that his old cost methods had required his constant attention, had warped his point of view and necessitated his performing many of the detailed control functions which were properly the duties of his plant and sales department heads and supervisors. He had had to review too many figures and so had gotten all bound up in the petty details of the business.

Also, he intimated, the department heads and some of the supervisors rather objected to his "meddling" before they had had a chance to work out their own problems. They felt, and both this executive and I believe rightfully so, that they had more intimate knowledge of the departments under their own direction and so could remedy a fault more certainly and quickly. One thing was certain: he knew he was not getting the best results, as his costs continued to be greater than the anticipated costs by some $115,000 a year.

With the installation of uniform costs which provide him with such tools of control as these articles describe, and prescribe for metal-working plants, he has been able materially to improve conditions. He uses as his criterion of cost activity the departmental profit and loss summary. It takes only two or three hours per cost period for him to familiarize himself with the results for the period and to learn what has been done to correct the cost excesses. He leaves the detail and actual control to the department heads and supervisors. This change has resulted in reducing the cost excess from about $115,000 a year to about $18,000.

Delegated Control

In the multi-plant business, departmental profit and loss summaries are especially essential to effective cost control. In such instances it is manifestly out of the question for management to exercise the detail control functions. They *must* be delegated to sub-executives, and supervision and management must rely on the departmental profit and loss summaries to check the control that is being maintained. Also the summaries for various plants for a cost period serve many comparative purposes. It should be necessary for management to refer to the digests only in exceptional cases where fundamental errors are brought to light by the summary.

The usefulness of the summary features was well demonstrated in one large business which operates eight widely separated plants. The final management responsibility is vested in a chief executive whose headquarters must necessarily be located in the East so that he can keep in intimate touch with financial and commodity markets.

During a three-months period in the spring and summer of 1933 there were extraordinary changes in costs brought about by unavoidable factors. Governmental activities increased the cost of some raw materials through special taxes and more difficult from a cost control point of view, wages for a number of employee classes were rising. As a result the costs of hundreds of products were affected, in varying ratios as between plants, for some of the plants were in the North, some in the South, some in large centers and some in small. All of this took place at a time when the management was especially hard driven with association and code negotiations, with contracting for raw materials, and with providing the increased working capital incident to greatly increased prices.

Throughout this unsettled period, the chief executive of this business was able to place upon the principal executives in the individual plants and the cost department head, the whole burden of cost revision and new price setting. He could delegate these vitally important duties with absolute confidence, for from the departmental profit and loss summaries for each plant he was able to make certain, with but brief study, that costs were under control.

Delays Prove Costly

During this three-months period business was at a considerably accelerated rate and upwards of $3,000,000 of business was booked. Delay or uncertainty in quotations would undoubtedly have resulted in the orders going elsewhere.

Contrast with the above favorable situation the troubles of an eastern manufacturer in the same line of business who readily could, but unfortunately did not, operate under uniform cost-finding and control methods. The methods actually in use consisted of individual improvisations varying with each plant and requiring frequent and laborious conferences with the chief executive each time conditions changed—as they did frequently during those troublous months of 1933.

During that period the management necessarily proceeded with uncertainty. There was always the fear that any reasonably adjusted price would be insufficient. For several days, the management actually refused to accept proffered orders, while struggling to arrive at conclusions as to costs. Evidently an important share of business they might have had went to competitors during this period, for while the industry as a whole showed a volume increase over a prior period of 30 per cent, the increase for this particular concern was but 8 per cent.

Lack of means for quickly and positively assuring the chief executive that costs were correctly established and under control was in this instance very expensive.

So much for the results control-wise that can be expected from intelligent managerial use of that valuable and concise control tool, the departmental profit and loss summary. Let us now turn to Fig. 11 and see what information it contains as well as how the information it contains is secured.

Sources of Information

The source for the major postings to the departmental profit and loss summary is the departmental analysis.

In Column 3 is posted the total unit added value for the productive departments. It will be recalled that this "added value" is made up of the total department expense and the direct labor. In other words, it is the total productive cost added to the material in producing the product. The total of this column for the productive departments is the amount of manufacturing expense and productive labor unit values charged to goods-in-process. Column 3 is the total of Columns 4 and 8 for the manufacturing departments.

The total unit added value for all productive departments is also a useful figure in the comparative judging of the productive activity of the company as a whole. This is particularly true in businesses where the costs have been completely unitized.

It is obvious that the sections of the columns which are cross hatched on Fig. 11 are irrelevant and therefore not used.

In Column 4 is posted the total direct labor unit amount for each department, which in turn is totaled for all departments. This total amount is the unitized direct labor amount that was charged to goods-in-process. The principal value of showing the direct labor unit amounts is for comparative purposes in judging the relation of the direct labor profit and loss to direct labor.

In Column 5 is posted the direct labor profit and loss which is in turn totaled for all departments. This is the amount by which the actual direct labor was corrected in obtaining the direct labor unit amount. The results shown in this column are, of course, the significant figures concerning direct labor for the cost period.

In Column 6 is posted by departments the expense profit and loss which is in

turn separately totaled for manufacturing and distribution departments. These total amounts are the amounts by which the actual manufacturing and distribution expenses were corrected in obtaining the expense unit amounts. Here again these expense profit and loss figures for both manufacturing and distribution departments are the pertinent control figures with respect to manufacturing and distribution expense for the cost period.

In Column 7 is posted by departments the controlled expense unit amount which is in turn separately totaled for the manufacturing departments and distribution department. The principal purpose in showing the controlled expense unit amount is for comparative purposes in judging the relation of the expense profit and loss to the controlled expense unit amount. Although the amounts above the block are included in the total for this column, they are thus set aside as the amounts for these departments, and together with their fixed expenses, are redistributed to the productive and distribution departments and are ultimately reflected in the department unit amount expense.

In Column 8 is posted by departments the department unit amount expense, which is in turn separately totaled for productive and distribution departments. The total for the productive departments is the basis for crediting manufacturing expense and charging goods in process with the manufacturing expense cost. The total for the distribution departments represents the allowed amount for distribution costs to be applied to the sales volume obtained for the cost period.

In Column 9 is posted, department by department, the manufacturing expense unit amounts charged to distribution departments. These amounts are in turn totaled. This serves as the journal entry basis for crediting manufacturing expense and charging distribution expense for services provided by the manufacturing departments for the cost period.

Column 10 provides a formal place for collecting charges from both manufacturing and distribution expense by departments to sundry general ledger accounts. The column is separately totaled for manufacturing and distribution credits and charges made to the appropriate accounts.

There may be individual desires as to other information to be shown on the departmental profit and loss summary. If such information is significant and if the summary is the proper record, it should be included, by all means. It is highly undesirable, however, to expand this summary until it becomes a catch-all for all sundry and irrelevant statistics.

It is usually desirable to show two profit and loss memoranda on the summary—one showing digest profit and loss and the other the departmental profit and loss.

The digest profit and loss memorandum sets up by sources all material, labor and expense profits and losses for the cost period. The sub-totals are so arranged that the total labor and variable expense sub-total proves with the departmental profit and loss memorandum.

The departmental profit and loss memorandum sets up from the totals on the summary the direct labor (Column 4) and the manufacturing and distribution controlled expense (Column 7) which, when added, is the total labor and variable expense, which checks directly with the sub-total by the same name under the digest profit and loss memorandum.

The presentation of the departmental profit and loss summary completes the control features of uniform cost-finding. It is evident that proper accounting, allocation, unitization and control are necessary to the establishment and maintenance of sound unit values. And sound unit values are indispensable prerequisites to reliable product cost determination.

PERIOD _____ 19__ **DEPARTMENTAL PROFIT AND LOSS SUMMARY**

DEPT NO.	DEPARTMENT NAME	TOTAL UNIT ADDED VALUE	DIRECT LABOR		EXPENSE			CHARGES TO	
			UNIT AMOUNT	PROFIT AND LOSS	CONTROLLED PROFIT & LOSS	CONTROLLED UNIT AMOUNT	DEPT. UNIT AMOUNT	DISTRIBUTION DEPARTMENTS	SUNDRY ACCOUNTS
	NON-PRODUCTIVE DEPARTMENTS								
1	ADMINISTRATIVE								
2	GENERAL OFFICE								
3	GENERAL FACTORY								
4	HEAT, LIGHT AND POWER								
5	GENERAL REPAIR AND MAINTENANCE								
6	EXPERIMENTAL AND RESEARCH								
7	HAULING								
8	RECEIVING, STORAGE AND SHIPPING								
9	TOOL MAKING, REPAIR AND MAINTENANCE								
	PRODUCTIVE DEPARTMENTS								
11									
16									
29									
	TOTAL MANUFACTURING								
	DISTRIBUTION DEPARTMENTS								
41	GENERAL SALES								
42	BRANCHES								
43	SALES STAFF								
44	ADVERTISING								
45	EXHIBITS AND DEMONSTRATIONS								
46	INSTALLATIONS								
47	WAREHOUSING, SHIPPING AND FREIGHT								
48	SALES PROMOTION								
	TOTAL DISTRIBUTION								

DIGEST PROFIT AND LOSS MEMORANDUM		DEPARTMENTAL PROFIT AND LOSS MEMORANDUM	
MATERIAL DUE TO PRICE			
MATERIAL DUE TO USAGE			
TOTAL MATERIAL			
LABOR		DIRECT LABOR	
MANUFACTURING VARIABLE EXPENSE		MANUFACTURING CONTROLLED EXPENSE	
DISTRIBUTION VARIABLE EXPENSE		DISTRIBUTION CONTROLLED EXPENSE	
TOTAL LABOR AND VARIABLE EXPENSE		TOTAL LABOR AND VARIABLE EXPENSE	
FIXED EXPENSE			
TOTAL			

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Fig. 11—A complete picture of manufacturing and distribution costs and the profit and loss for a cost period is obtained from the departmental profit and loss summary

EDITORIALS

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EDITORS

Better—Thank You

Despite the gloomy forebodings expressed by some business men, and diligently disseminated by certain newspapers, industry is feeling better.

Proof? A survey of thirty industrials in various fields located in what has been considered to be a particularly pessimistic city shows the heads of nineteen of them to be optimistic over prospects, nine discouraged, two non-committal. A gear shop, running nearly full for weeks, reports in November its best day's orders since 1929.

Isolated instances? Yes, but enough of them to prove correct the statement of one machinery dealer that business is better than most of us realize, or will admit.

Compliance on Labor Clauses

Most codes of fair competition are lacking in one important particular—they fail entirely to make provision for handling questions involving wages, hours and working conditions. A misunderstanding as to the powers of the "Code Authorities" appears to be responsible for this failure.

Apparently many code framers were under the misapprehension that the Code Authority, made up of representatives of their industry and governmental appointees, had jurisdiction over labor provisions. That such assumption is directly contrary to official ruling is evident from a statement made by General Johnson, on November 4, as follows:

"The organization of very few industries is at this time appropriate for the adjustment of complaints of violations of the labor provisions of codes. While, in every case, where the authority is organized, adjustment of fair trade practices will be left to the Code Authorities, as a general rule the code provides no plan for the adjustment of their labor provisions. The Code Authority will be permitted to function on labor disputes when provision is made for adequate representation of labor on all committees, boards or other agencies set up to entertain and adjust complaints by employees against their employers for violations of labor provisions."

As now set up, the machinery for handling labor clauses in the codes is vested in the chiefs of district offices of the Department of Commerce who have been temporarily designated as Directors of Compliance. Secretary Wagner's Labor Board will continue to function where disputes have developed into strikes. But industry does not appear in this arrangement except in the few instances where a special authority with labor representation has been created to pass on labor questions.

It is the part of wisdom, therefore, that codes, lacking in this respect, be amended at once to provide labor committees with adequate labor representation. Otherwise, employers will have no voice, through their Code Authority, in the enforcement of code labor clauses.

Lost Motion in Large Plants

Inertia seems to be as inevitable in the management of large plants as in the moving of large bodies. Two reasons are the size, and the unwillingness, if not the impossibility, of giving authority to those down the line who make first contact with the outside world.

A very large company has one of its units built in a small shop in a different town. Those who contact both places greatly prefer to deal with the small shop. In addition to the advantage of personal contact, much valuable time is saved on both sides by being able to cut out many formalities and much routine. In the large plant there is the almost inevitable wait in the administration building, the time lost in getting from the office to the department wanted, and frequently the difficulty of seeing the overburdened executive sought.

It should be remembered that whatever adds to the cost of selling must of necessity be included in the price the buyer pays. The purchaser must pay the total costs, plus a profit, if business is to continue. Whatever adds to the cost of making contacts is a boomerang that hits the buyer in the end.

Make It a Family Party

Much of the success in bringing about industrial recovery lies in securing amicable working agreements between management and employees. Generally speaking the concerns in which personnel relations have been good in the past are having no difficulty at present. Where relations have been fair and friendly there is usually no trouble in reaching agreements satisfactory to both sides.

Bringing in outside representatives of either side makes amicable settlements more difficult, even though the right to do so cannot be disputed ethically or legally. Nor is the trouble all on one side. Mediators who have been highly successful in securing equitable agreements assure us that they are always more dif-

ficult when lawyers on either side bring up hair-splitting points and introduce legal phrases. Realizing that lawyers who are not paid a yearly retainer depend on controversy for their income, it behooves both sides to employ only such attorneys as are genuinely interested in reaching a settlement rather than on prolonging discussions.

Informal consultations on a friendly basis, and without benefit of attorneys, will in most cases give much more satisfactory results than long drawn out controversies. Most men prefer to deal directly with their own employer where past contacts have been satisfactory. The best method of preventing objectionable organizing is to maintain informal, friendly relations throughout the organizations without dragging the company lawyer into what should be a family party.

A By-Product

Opinions differ frantically over the theoretical soundness and the practical wisdom of the President's policy of endeavoring to raise the price level by manipulating the gold value of the dollar. So far as we can see, about the only real harm done has been to the confidence of those business men whose plans for development and expansion have been set back thereby.

On the other hand a very valuable by-product has certainly been recovered. Ask any exporter what he thinks about the monetary policy and you will get but one answer. His order book is all the evidence he needs.

Much of the recent improvement in machine tool orders is traceable to the same source. Domestic business is fluctuating very little but foreign business has improved appreciably. Only a by-product perhaps, but what a welcome one!

• CHIPS •

Washington—Roosevelt sticks to controlled currency plan despite resignation of Sprague and opposition of leading bankers and others . . . Johnson announces regulations on NRA code compliance and labor relations . . . Douglas warns that taxes on middle class will be heavier . . . Proposal to consolidate Navy and Coast Guard starts vigorous discussion . . . General MacArthur reports Army reduced in strength below the danger point, particularly as regards equipment, much of which is "useless for battle" . . . Morgenthau proposes to stop income tax leaks to raise new income . . . Al Smith charges PWA failure . . . Goodyear-Zeppelin officials propose building of two passenger-carrying dirigibles with PWA funds . . . Repeal of the 18th Amendment becomes a fact and authorities struggle with the regulation problem . . . NRA codes to be used by Federal Government . . . Ford wins his argument as Secretary Wallace gives him order for 700 CCC trucks.

Foreign—Soviets promise to abstain from propaganda in U. S. . . . Protestant clergy in Germany against Hitler "heathendom" . . . Great Britain takes over Newfoundland government until economic crisis passes . . . Sarraut cabinet falls in France . . . Chautemps forms a successor . . . Argentine NRA plan like Roosevelt's and expected to aid it.

Finance—duPont votes 75-cent extra dividend . . . U. S. Chamber demands stabilization of dollar, Acting Secretary Morgenthau raises the price of gold some more . . . Insurance companies announce dividend reductions for 1934 . . . Internal revenue up over $300,000,000 in four months . . . Parleys find basis for credit to Soviets . . . N. Y. Central disposes of 50,000 shares of Lehigh Valley stock . . . Chesapeake Corp. raises quarterly dividend on strength of better C. & O. earnings . . . Government buys bonds, "as investment"—Morgenthau . . . Savings bank deposits are $3,000,000,000 less, thanks to hoarding . . . Firestone earnings at nearly $3,000,000.

Industry—NRA through New York Regional Labor Board brings suit against shipbuilding concerns for refusal to bargain with employees . . . Withdrawal of RFC loans threatened . . . Nash settles labor dispute, reopens Kenosha plant . . . Seaboard Air Line cuts coach rate to 1½ cents a mile . . . Beginning Jan. 1, 1934, all duPont employees will get at least one week vacation with pay . . . Van de Graaf develops 5,000,000 volts in artificial lightning tests at South Dartmouth . . . Industrial Conference Board reports increase in wages but a greater increase in living costs . . . General Motors announces "knee-sprung" cars for 1934, oblivious or contemptuous of the old horseman's meaning of the term . . . Aluminum and telephone industries likely to get special codes because of monopolistic situation . . . General Motors breaks ground for new building at Tarrytown plant.

Trade—Groups formed in Washington to expedite trade with Russia . . . Bilateral trade treaty with Columbia negotiated . . . I.C.C. refuses to suspend store-door delivery plan of P.R.R., Erie and Grand Trunk despite protest of other Eastern railroads . . . Lackawanna, B. & M., C. & O., Nickel Plate and Pere Marquette fall in line with similar services . . . Wholesale prices drop 1 per cent . . . Iron and steel and machine tool exports up sharply.

Indicators—Electrical energy production drops slightly but is well ahead of last year . . . Business Week index drops fractionally to 60 . . . Carloadings up a little contrary to seasonal trend . . . American Iron and Steel Institute reports steel plants operating at 28.3.

Machine Tool Builders Elect Supervisory Agency

Meeting in Washington at the Wardman Park Hotel on Nov. 27 and 28 to elect a code authority, or supervisory agency as it is termed in their code, the National Machine Tool Builders' Association also elected three new directors, and officers for the ensuing year. The new directors are George H. Benzon, Jr., William Sellers & Co., Norman D. MacLeod, Abrasive Machine Tool Co., and George H. Johnson, Gisholt Machine Tool Co. E. A. Muller, King Machine Tool Co., was re-elected president; Charles J. Stilwell, Warner & Swasey Co., 1st vice-president; Herbert H. Pease, New Britain-Gridley Co., 2nd vice-president; and H. S. Robinson, Cincinnati Shaper Co., treasurer.

The session which elected the supervisory agency was a general meeting of the machine tool and forging machine industry attended by N.M.T.B.A. members and non-members as well. The following were unanimously elected to serve on the supervisory agency: Henry Buker, Brown & Sharpe Mfg. Co.; R. M. Gaylord, Ingersoll Milling Machine Co.; James E. Gleason, Gleason Works; Herman H. Lind, general manager, N.M.T.B.A.; Henry M. Lucas, Lucas Machine Tool Co.; August H. Tuechter, Cincinnati Bickford Tool Co.; Wendell E. Whipp, Monarch Machine Tool Co. The supervisory agency was empowered to fill vacancies occurring in its membership subject to ratification by the next succeeding convention.

In the course of his report to the N.M.T.B.A., General Manager Lind made an earnest plea for the members to undertake the task of educating congressmen on the capital goods industry. He pointed out that although the great majority of these men are anxious to do the right thing, they are generally quite unfamiliar with the problems of the manufacturers engaged in building capital goods. No other group is in so favorable a position as the machine tool builders to undertake such education, because they sell to capital goods manufacturers as well as being engaged in their manufacture in their own plants.

James W. Hook, president of the Geometric Tool Co., and connected with the NRA Industrial Advisory Board since August, observed that the original intent was that NIRA was a permissive act, and that its principal function was to clear up bad situations in the textile, coal, petroleum and a few other industries, leaving those industries that were running along smoothly to continue as they were. Unfortunately there have been vigorous efforts to win selfish advantage through influence. If these do not cease it is more than likely that drastic regulatory legislation will succeed the permissive NIRA. The first three months of NRA experience has proved conclusively that it is impossible to regiment industry and that regulatory legislation would be a calamity.

Industry has submitted some 1,200 codes of which well over 100 have been signed. If the program fails the failure cannot be charged to industry because the major part of industry has cooperated to the best of its ability. It has probably been unfortunate that General Johnson's colorful personality has concentrated attention on NRA which is, after all, only one of seventeen acts under the New Deal. In general, these acts contemplate a more equitable distribution of income which is commendable but entirely at odds with the parallel effort to restrict income arbitrarily by fixing a short working period. Penalty overtime rates would have made such an effort self-regulatory and flexible.

A very real possibility in the near future is a super planning board set up by Presidential edict to distract attention from the monetary mix-up. If this is inavoidable industry must make sure that it is adequately represented on this board. Such a board should be free from relations with any existing body such as the Chamber of Commerce of the U. S. Representatives elected by the various code authorities would speak much more authoritatively for industry.

Speaking at the formal banquet, Secretary of Commerce Roper expressed the opinion that recognition of Russia would not result in a sudden increase in business but rather in a slower and more healthy gradual increase as ways and means of trading are discovered. Deputy Administrator Malcoln Muir explained recent developments in NRA policy and procedure and enlarged on the opportunities for the capital goods industries. He said, in part:

"General Johnson, in his message to the President, which is embodied in the

E. A. Muller

code as published, recognizes your contribution to reemployment and to public purchasing power, and I, knowing your industry and its problems as well as I do, want to add my hearty congratulations to your public-spiritedness in drawing up a code which, it is hoped, will increase employment approximately 12 per cent and payrolls approximately

INDUSTRIAL REVIEW

Suppliers of machinery are distinctly encouraged by sales for November, which resisted the usual seasonal decline and, according to preliminary reports, held the level reached in October. Export and government business made this possible by offsetting a slight recession in domestic trade. However, several mid-western centers report that November domestic sales have held up well.

Possibly because of their familiarity, monetary uncertainty and NRA codes are less of a retarding influence. It is generally felt that, while the usual December dip will occur this year, the long term prospect is bright.

In the East domestic business for November was definitely below that for the previous month, but the rise in foreign sales made up for this decrease. Cincinnati reports purchases by Amtorg and, within the past few days, a general increase in activity which includes the supply business.

Detroit has been hit by the auto show spirit and enjoys a temporary rush for small tools and supplies. Many inquiries for capital goods are in circulation with the assurance that they will be translated into orders when improved auto sales for 1934 can be definitely forecast. The habit of holding orders until the last minute still prevails.

Chicago, marking time, still maintains the plateau scaled in October, with healthy prospects. The Milwaukee R. R. list gives promise of activity from a quarter long dormant.

Milwaukee, too, is quite satisfied to have held the October level during November. In St. Louis, November billings reached a peak for the year despite some slackness in small tool lines.

20 per cent in your industry. I know that that means a temporary sacrifice on your part—but if all the other industries whose codes have not yet been drawn approach the problem with your spirit I know that the sacrifice will be only a temporary one.

"You are all deeply concerned, I know, and want to know what consideration NRA is giving to the capital goods industries and what the administration's attitude is toward this whole question of the purchase of machinery.

"I cannot emphasize too strongly to you the fact that NRA is alert to the need for stimulating buying in the capital goods industries.

"It is unfortunate that in the confusing, early days of NRA the idea was allowed to get abroad that no new machinery was to be bought by industry. Since then, soberer analysis has shown that unless we have recovery of the capital goods industry, we shall have no real general recovery.

"Now that many industry codes have been accepted, business finds some manufacturing executives are sad, some are happy. The latter are those who have low-cost plants. They find they have an economic advantage. Keep in mind that the NIRA codes prohibit an individual manufacturer selling below *his own* cost—but not below his competitor's cost. So the low cost plant can use this economic advantage several ways—might even sell at the same price as its competitors and use the extra profit for more salesmen, for redesign of products, for improved quality."

NRA Changes Clarify Plans For Industry Control

WASHINGTON—Compliance or enforcement plans of NRA moved into a new phase last week with considerable attending fireworks. General Thomas S. Hammond, former head of PRA, recently chief of the trade association division of NRA, resigned when a new plan of compliance, centralizing the functions with code authorities and setting up a strong compliance division, was announced. His retirement was not based on a clash with General Johnson, but frankly on a feeling that the trade association work, as now set up, was for the present, at least, temporarily eclipsed by the new plan.

William H. Davis, New York patent lawyer, and one of the able new deputies in NRA, was moved up to become National Compliance Director, a post which had been occupied temporarily first by General Johnson and then for two weeks by the Assistant Administrator for Industry, Colonel Robert W. Lea. L. D. Tompkins, vice-president of the United States Rubber Co., was moved into the powerful new post of special assistant administrator to organize the trade practices branch of compliance, the most important post yet occupied in NRA by an active industrialist. He becomes one of the powerful figures in NRA, subject to special assignment by the Administrator.

Another important move is that General Johnson's son, Lieutenant Kilbourne Johnson, becomes chief of the administrative branch of the compliance division, replacing Major Royale, and Frank Healy, until now chief of PRA, moves into another assistant national compliance directorship. His change of status marks, probably, the end of the PRA division and the moving of the Blue Eagle out of its controversial perch as symbol of PRA and into its new job of symbol for code compliance.

The procedure of compliance enforcement at NRA is set down carefully in new rules issued regarding the routes of complaints against violation of the code provisions. The line follows generally that laid down in previous suggested methods of procedure, the complaints filed with regional directors of compliance (26 at present, more to come), passing up to deputies and division administrators, reassignment to code authorities when they are fully organized with their official membership as well as that from the industry, and labor questions going to the code authority when and if it has established a subcommittee on labor with full (usually equal) representation of labor. When the code authorities are set up "full publicity" is to be given to the fact that they are to receive all complaints direct. Until then, regional compliance directors will act.

The whole plan is becoming much more closely coordinated than seemed possible two weeks ago. The Swope plan, with its far visioned set-up of a powerful master Chamber of Commerce and Industry is considered, at NRA, as a distant ideal, which when realized may very well bring such pressure on NRA as to take back much of the influence which NRA, by the present and proposed set-ups, has over code enforcement. But for the present, there is no intention of waiting for trade associations to grow strong and able to carry the enforcement load. The code authorities of industries where the trade association is now functioning well will supposedly be named and dominated by the trade associations; otherwise, they will contain the names of men eminent in the industry, chosen for their abilities and standing, with the three government nominees as highly important members although they have no vote, only the veto which General Johnson calls the substitute for the anti-trust laws under NRA.

Diesel Hearing Used for Labor Attack on MAPI

At the public hearing of the Diesel Engine Manufacturing Industry held November 22, William Green, president of the American Federation of Labor made a personal protest against the 40-hour work week, the 40-cent minimum wage rate and other provisions embodied in the code. This attack was made because the diesel code is sponsored by the Machinery and Allied Products Institute. Mr. Green stated that "at least forty other codes" sponsored by MAPI would be affected and that, therefore, consideration of the terms presented a "grave responsibility" to NRA. Mr. Green also asked for labor representation on the code authority, saying that workers were "equally important as capital in the industrial scheme" but that this and other codes gave labor only "minimum recognition."

Harry J. Carr, general vice-president of the International Association of Machinists, detailed a presentation of labor's demands. He asked a 35-hour, five-day work week, a minimum wage for unskilled labor of 45 cents an hour, asserting "this industry with the huge profits it piled up in boom times can well afford to pay 45 cents to the small proportion of common workers." He argued that the proposed 40-hour week would only add to unemployment, and because of the list of exceptions, the clause covering maximum hours "doesn't mean a thing." Mr. Carr also attacked the proposed wage differential of 5 cents an hour in favor of plants located in small towns, but Assistant Deputy Administrator, Leonard S. Horner who presided at the hearing insisted that such a differential was necessary.

E. C. Davison, general secretary of the International Association of Machinists, stated that if the labor provisions sponsored by the Institute were approved, it would mean the "practical failure of the recovery program." He declared that the diesel engine and allied capital machinery industries were "mere

puppets of this master organization." Mr. Davison said that the four codes sponsored by the Machinery and Allied Products Institute, which had already been approved, were all unfair to labor.

The code was presented by W. C. Dickerman, chairman of the code committee, and F. E. Neagle, counsel for the committee. Mr. Dickerman pointed out that employment in the industry had fallen off 51 per cent since 1929 and that sales for the first three months of 1933 were only 19.3 per cent of those for the first quarter of 1929. In support of the code, John W. O'Leary, president of the Machine and Allied Products Institute, made a short statement.

Heater Manufacturers Adopt Code

On November 24 members of the Indirect Water Heater Manufacturing Industry decided to subscribe to the code of fair competition approved by President Roosevelt on October 11 for the Heat Exchange Industry. A separate code submitted by this group was withdrawn, and the public hearing originally scheduled to be held on November 27 was cancelled.

Lea Heads Code Authority Committee

"To assist and advise both deputy administrators and existing code authorities on organization and procedure for compliance with codes," Colonel Robert W. Lea, assistant administrator, was recently appointed by General Johnson as chairman of the new Code Authority Organization Committee. Other members of the committee are Dr. Leo Wolman, chairman of the Labor Advisory Board; Louis Kirstein of the Industrial Advisory and National Labor Boards; Dr. Wilson Compton of the NRA trade association division; Blackwell Smith, associate general counsel of NRA; and Franklin S. Pollak of the NRA compliance division.

Chief functions of the committee will be to submit to the administrator proposed model administrative provisions for future codes; to analyze administrative provisions in existing codes and wherever necessary, submit proposed modifications; to consider and advise on plans proposed for code authority and trade association organization for industrial self-government; to advise and assist deputy administrators in effecting the organization of the industries for code administration.

President Approves Machine Tool Dealers' Code

On November 27 the code of fair competition submitted by the Associated Machine Tool Dealers received official sanction. The approved code showed considerable revision from the initial draft published in these pages (*AM*—Vol. 77, page 596d).

Article I, covering purposes of the code, was shortened to one brief sentence. Article II, on definitions, was lengthened and made more specific in accordance with legal practice developed by NRA. The new Article III covers hours and practically duplicates the 40-hour week with qualifying clauses originally set up.

Wages, according to the approved code have an established minimum from $14 to $15 a week, depending on population. Article IV, which covers this subject, also specifies that there shall be no reductions and that salaries over the minimum shall be equitably adjusted.

The old Article VII on supervising agency is replaced by Article V in the new code entitled Administration. This provides that the code committee shall constitute a temporary supervising agency. Within 60 days after the code becomes effective, a permanent agency is to be set up including seven members of the trade and not more than three members representing the administrator. At least five of the seven trade members are to be members of the Association. This article also outlines in detail the powers and duties of the supervisory agency.

However, the greatest changes from the original draft are found in Articles VI and VII, covering trade practices and trading area committees. These, as finally revised by the code committee, are as follows:

ARTICLE VI—TRADE PRACTICES

1. Unfair practices shall be deemed to be practices or acts which by subterfuge, concealment, misrepresentation, or by any form of discrimination, result in selling below published prices, or in deceiving or misleading purchasers, or in misrepresenting the goods of competitors.

The following specific practices constitute unfair methods of competition for members of the Trade and are prohibited.

2. False Marking or Branding: The false marking or branding of any goods which has the tendency to mislead or deceive customers or prospective customers, whether as to the grade, quality, quantity, substances, character, nature, origin, size, finish or preparation of any such goods or otherwise.

3. Misrepresentation or False or Misleading Advertising: The making or causing or knowingly permitting to be made or published any false, materially inaccurate or deceptive statement, by way of advertisement or otherwise, whether concerning the grade, quality, quantity, substance, character, nature, origin, size, finish or preparation of any goods of the Trade, or the credit terms, values, policies or services of any member of the Trade, or otherwise having the tendency or capacity to mislead or deceive customers or prospective customers.

4. Commercial Bribery: Directly or indirectly to give or permit to be given, or offer to give, money or anything of value to agents, employees or representatives of customers or prospective customers, or to agents, employees or representatives of competitors' customers or prospective customers, without the knowledge of their employers or principals, as an inducement to influence their employers or principals to purchase or contract to purchase from the makers of such gifts or offers, or to influence such employers or principals to refrain from dealing or contracting to deal with competitors.

5. Interference with Contractual Relations: Maliciously inducing or attempting to induce the breach of an existing oral or written contract between a competitor and his customer or source of supply, or interfering with or obstructing the performance of any such contractual duties or services.

6. Secret Rebates: The secret payment or allowance of rebates, refunds, commissions, credits, or unearned discounts, whether in the form of money or otherwise, or the secret extension to certain purchasers of special services or privileges not extended to all purchasers on like terms and conditions.

7. Giving of Prizes, Premiums or Gifts: The offering or giving of prizes, premiums, or gifts in connection with the sale of goods, or as an inducement thereto, by any scheme which involves lottery, misrepresentation or fraud.

8. Defamation: The defamation of competitors by falsely imputing to them dishonorable conduct, inability to perform contracts, questionable credit standing, or by other false representations or by the false disparagement of the grade or quality of their goods.

9. Threats of Litigation: The publishing or circulating of threats of suits for infringement of patents or trade marks or of any other legal proceedings not in good faith, with the tendency or effect of harassing competitors or intimidating their customers.

10. This Trade is engaged in the business of distributing machine tools to industrial users and not to the general public, some of the product is sold direct by the manufacturer, some by commission salesmen and agents and all resales are on a commission basis. Therefore, that open prices may be maintained without discrimination, it is established that the individual manufacturers published prices shall govern. Therefore, no members of the Trade shall deviate from the manufacturer's f.o.b. factory published price lists and discounts, or sell directly or indirectly by any means whatsoever, any of such goods at a price lower or at discounts greater than those provided in the manufacturer's current net price lists or price lists and discount sheets, except damaged and obsolete goods, and then only after being reported to the Supervisory Agency.

11. To quote a lump sum price on any schedule of goods which does not show unit prices, or to make any additions or reductions on any other basis than the unit prices shown.

12. To quote delivered prices on invoice purchaser without adding to the f.o.b. factory prices, transportation, and other charges and failure to state in quotation where freight is prepaid that such prepaid freight will be charged as a separate item and billed net cash.

ARTICLE VII—TRADING AREA COMMITTEE

Section 1. The Supervisory Agency shall establish in each trading area a Trading Area Committee of not more than three members of the Trade to assist in administering this Code within such trading area, subject to review of the Administrator.

Section. 2. Each Trading Area Committee may establish, subject to the approval of the Supervisory Agency and the Administrator, a trade-in plan to govern all members of the Trade within the jurisdiction of such Trading Area Committee.

General Johnson Explains Code Administration

In order to explain the many questions that have arisen on the subject of code administration, General Johnson recently released a statement on the subject. Many of the code authorities as now set up do not fully meet NRA requirements either as to representation or powers. A study of General Johnson's statement should aid committees now in the process of framing codes, and industries having approved codes in making suitable revisions. The text of General Johnson's statement follows:

"Practically all codes provide that the code authority thereof is to administer the code. It is the duty of the deputy administrator for that code to see that:

(a) Administrative provisions appropriate to the particular industry are included in each code.
(b) That the code authority is organized in such a way that it may promptly and efficiently administer the code.
(c) That the code authority does efficiently administer the code.
(d) That the government moves promptly to administer the code where the code authority has failed or is unable to administer the code, or is abusing its authority.

"There are two aspects to code administration; one, planning and progress, and two, compliance.

"The term 'Normal Code Administration' is intended to include such functions as:

(a) Economic planning and research for the industry.
(b) Reports and recommendations of conditions in the industry.
(c) Collection of statistical data, preparation of cost accounting methods.

"The term 'Administration for Compliance' is intended to include:

(a) The instruction and education of those subject to the code as to their responsibilities thereunder so as to anticipate and avoid complaints of non-compliance.
(b) The adjustment of complaints of non-compliance by education, fair findings of facts, and the pressure of opinion within the industry.
(c) The adjustment of complaints by arbitration, conciliation, and mediation.
(d) The rendition of reports to the enforcement agencies of government in those cases where all other means have failed. Such reports should be based upon adequate findings of fact.

"It is fundamental, within both the letter and intent of NIRA that as much as is possible and appropriate of both aspects of code administration be effected by industry itself. This should be done through the code authority (specifically provided for in each code). A trade association may be, or may select, or may be used by a code authority, as provided in the code. It is the policy of NRA to build up and strengthen trade associations throughout all commerce and industry.

"It is equally fundamental, within both the letter and intent of NIRA, that the ultimate responsibility for efficient code administration lies with NRA. NRA will supervise code administration by code authorities. In addition, it will directly administer the code itself, wherever an industry is unable to administer it, fails to administer it, or where there are certain functions of code administration, which by their nature, government should perform directly.

"As soon as a code authority is set up and ready to function, it will usually be well enough organized to adjust most complaints of violations of the trade practice provisions of the code. Such complaints involve the rights of one employer against another employer within the industry. Trade associations and other existing agencies of industrial self-government are well suited to the handling of this type of complaint, although, of course, the public interest must be safeguarded by general governmental exercise of a veto. This governmental veto power is the substitute for the anti-trust laws in this new set-up. In most cases, the government representative on a code authority sits without vote, but with a veto.

"The function of securing compliance with the labor provisions of codes presents a much more difficult problem of organization and administration. Very few industries are organized at this time along lines suitable to adjustment and fact finding in this type of case. Complaints of violations of labor provisions should not be referred to code authorities (or any agencies of industrial self-government to which the code authority may delegate its compliance functions) unless such agencies have adequate labor representation thereon. Most codes do not provide for such representation. Wherever, as in the bituminous coal industry, it proves feasible and appropriate to provide regional or divisional labor boards to entertain and adjust complaints of labor violations, such a system will be approved. In other cases, complaints may be referred to the National Industrial Labor Board.

"The problem of code compliance, by its very nature, requires a regional system of fact finding and adjustment agencies appropriate to the handling of labor complaints. In order to protect the interests and rights of an employee under a code, the employee must be furnished with an agency convenient in location and impartial in nature. The government has provided twenty-six regional compliance agencies, to which complaints of code violations may be referred where there is no approved machinery within the industry to handle such complaints. It is anticipated that as the volume of complaints increases this regional set-up will have to be extended along State lines and if it becomes necessary, as it doubtless will, in many cases local agencies will be provided for. These local agencies will report up through the State agencies. This governmental regional organization is a part of the Compliance Division in NRA under the direction of the national compliance director.

This system will fill the blanks in industrial self-government. It will act for an industry while the industry is organizing to handle such compliance problems for itself; or where an industry in a certain territory has no agencies of industrial self-government; or where an industry, though organized to handle trade practice complaints, has no machinery approved to handle labor complaints; or where approved machinery has failed to adjust a complaint.

"Ultimately all complaints unadjusted by agencies for industrial self-government which are reported up through an industry will be referred to the Compliance Division of NRA. If the Compliance Division is unable to effect an adjustment, such complaints will be referred to the National Compliance Board, which will refer the complaint to the proper enforcement agencies of the federal government, if it is unable to handle it otherwise.

"In order to assist and advise both deputy administrators and existing code authorities on organization and procedure for compliance, a special Code Authority Organization Committee has been appointed in NRA.

"The Deputy Administrators have been instructed to keep the Compliance Director constantly informed as to which agencies of industrial self-government are to handle certain types of complaints in certain territories. In order to stimulate organization for industrial self-government, a Deputy Administrator may instruct the Compliance Director to refer all of a certain type of complaint to an agency of industrial self-government on 'time limit notice.' This means that all of this type of complaint filed with a district compliance director will be referred to the code authority with instructions to report back within a certain fixed time to the district compliance director as to the final disposition of the case. After a trial of this method, the deputy administrator may find that a code authority and its regional organization is fully equipped to handle efficiently all such complaints and will inform the national compliance director to this effect. Publicity will be given to such instructions so that all interested parties may know that the proper place to complain is to the code authority agency. Thereafter, all complaints will be

Exports of Machinery During October, 1933

	Oct. 1933	Sept. 1933	Oct. 1932
Electrical machinery and apparatus	$4,592,168	$3,871,465	$3,889,807
Power generating machinery (except automotive and electric)	394,863	312,155	296,712
Construction machinery	238,552	174,033	259,874
Mining, well & pumping machinery	1,380,744	1,218,137	741,580
Power-driven, metal-working machinery	930,947	625,118	1,392,429
Other metal-working machinery	113,490	83,234	98,943
Textile machinery	971,370	421,904	714,823

Exports of Metal-Working Machinery During October, 1933

	Oct. 1933	Sept. 1933	Oct. 1932
Engine lathes	$40,007	$19,858	$40,964
Turret lathes	30,635	14,563	6,149
Other lathes	41,953	9,685	57,952
Vertical boring mills and chucking machines	15,490	3,524	9,740
Thread-cutting and automatic screw machines	11,812	32,066	49,991
Knee and column type milling machines	12,673	15,933	58,392
Other milling machines	81,580	18,857	138,381
Gear-cutting machines	42,546	67,059	148,074
Vertical drilling machines	1,395	10,553	2,032
Radial drilling machines	12,289	3,068	48,239
Other drilling machines	46,021	36,435	124,790
Planers and shapers	15,689	1,100	24,405
Surface grinding machines	14,061	10,611	8,410
External grinding machines	33,206	9,295	78,169
Internal grinding machines	37,719	21,170	24,921
Tool grinding, cutter grinding and universal grinding machines	28,275	20,012	24,132
Other metal-grinding machines	59,700	21,345	68,376
Sheet and plate metal-working machines	144,506	48,475	153,638
Forging machinery	24,844	59,350	35,565
Rolling mill machinery	47,289	35,090	48,681
Foundry and molding equipment	16,475	44,644	23,966
Other power-driven metal-working machinery and parts	170,782	122,425	207,462

Other Metal-Working Machinery

Pneumatic portable tools	25,806	20,321	25,646
Other portable and hand or foot operated metal-working machines and parts	38,400	26,017	21,356
Chucks for machine tools	6,145	4,581	3,939
Machine operated pipe and thread cutters, stocks, dies, taps and other machine-operated tools	21,551	17,218	26,266
Other metal-working machine tools	21,588	15,097	21,736

adjusted within the industry and only such complaints as the industry fails to adjust will be referred to NRA.

"However, even where an industry is completely organized to adjust all complaints, it may still be advantageous for it to call upon governmental agencies to supplement its functioning. Thus, the preliminary investigation of some types of complaints may be done by a regional governmental agency and the facts reported This again illustrates the fundamental theory underlying NIRA of industrial self-discipline wth governmental partnership. Such a partnership, together with representatives of industry on governmental advisory committees constitutes an effective guarantee against bureaucracy."

Questions Raised on Machinery Codes and Their Answers

Q. We have a man trained to do certain jobs around the plant including supervision and maintenance of our oil burners. He qualifies as fireman but also does other jobs, acting as janitor, day watchman, and general utility man for any job that comes along where an extra man is needed at that particular time. He has averaged approximately 51 hours per week. If necessary to cut his hours to 40 it would entail considerable burden upon us.

A. This man undoubtedly would come under the "watchman, fireman and maintenance" provision. Hours unlimited, but recommend not in excess of 56.

Q. Is it permissible and advisable to start a new calendar period January 1 for counting up the 6 weeks in 6 months' allowable 48 hours? In other words, may we work 48 hours per week for 6 weeks between now and January 1st, and then start a new period January 1st, to July 1st?

A. No. The 6 weeks need not be consecutive weeks, but the 6 months' period must be 6 consecutive months reckoned from the date that the 48-hour privilege is first used.

Q. Assuming that some employees had worked six 44-hour weeks or 264 hours, would it be permissible to let those employees make up the other 24 hours within the 6 months' period provided they do not work more than 8 hours in any one day?

A. Yes.

Q. Can our apprentices work over 40 hours a week if we pay them time and a half in excess of 8 hours a day? Can our apprentice draftsmen work over 40 hours a week under same conditions? How much must we pay our apprentices both in shop and drawing room? When we employ an apprentice for the shop, he starts by sweeping up the shop, then cleaning castings, then sweeps up again, then paints castings. Is he permitted to do this during the beginning of his apprenticeship?

A. Apprentices who come within definition of (Machine Tool) code are exempt from other provisions of Article IV. Apprentices should pursue the same course of training under code as they did before the code was put through.

Q. What is to prevent putting your shop men on a salaried basis and working them as long as you want to?

A. The first part of Article III limits employees receiving less than $35 a week to 40 hours. Reclassification of employees while upon the same type of work is frowned upon by the Recovery Administration.

Q. We are paying a draftsman on an hourly basis according to rate based upon a normal 44-hour week at $35. In case such a draftsman works less than 44 hours, with a consequent pay of less than $35, does he come within time and a half for overtime for hours over 8 per day, and is he limited to 40 hours per week?

A. The salary clause of $35 per week is understood to mean a guaranteed $35 per week on the generally understood salary basis. Anyone working on an hourly basis, irrespective of what the wages would be if a full week is worked, is considered an hourly worker and would come under the overtime class. If he is a member of the technical staff and his salary is $35 per week or more, he would not come under the 40 hour limitation.

Q. We cannot employ machinists. We have advertised and written shops in this locality who employ good machinists and not one of them can refer us to any men out of work. Local NRA tells us they can do nothing for us. We have orders on which delivery should be made promptly. We do not want real machinists as listed by the U. S. Government. All we want are fair machinists who know how to run two or three machine tools. What are we going to do about it?

A. There is no answer to this one.

Kiplinger questions and answers—taken from letter of November 18:

Code Compliance. Does a unit have to adjust wages, hours, etc., in accordance with industry's code even though unit does not join association presenting code?

A. Yes.

Government Contracts. A dealer, operating under a code, bids on government contract. Manufacturer who furnishes goods to dealer is not operating under a code. What is status of dealer?

A. Bid probably would be rejected unless it was known that the manufacturer was complying fully with provisions of the code even though he had not actually signed it. This is generally in line with Ford case.

Open Prices. A unit claims to be injured by "open price activities" of an industry and objects to furnishing price information required by Code Authority. Is unit compelled to abide by that section of the code?

A. Yes.

Uses of Fines to be collected for code violations. Will they be turned over to government or go toward Code Authority administrative expenses?

A. No definite ruling, but probably go to Code Authority.

PWA Allotments Delayed

PWA plans to throw some business to the capital goods industries by financing railroad buying are still in the paper stage. The hoped-for reaction did not materialize following announcement a month ago of an $84,000,000 loan to the Pennsylvania's Railroad and an allotment of $51,000,000 to finance purchase of rails by 50 some other roads.

The contracts with the Pennsylvania have been held up by difficulties encountered in attempting to reconcile PWA labor requirements with railroad practice. Loans to other roads for purchase of rails are waiting upon an examination of their financial condition. Loaning funds without security is a ticklish question in some cases and these are the very roads that do not have acceptable collateral.

Frank Wright, director of PWA's transportation loan division issued this week a circular of instructions on information required with applications for loans to finance railroad maintenance and equipment, and elimination of grade crossings.

Truck Association Elects Clark

Election of officers in the newly organized Gas-Powered Industrial Truck Association resulted in the following: president, Ezra W. Clark, vice-president, Clark Tructractor Co., vice-president, L. J. Kline, general manager, Mercury Manufacturing Co.; secretary-treasurer, John A. Cronin. In addition to the president and the vice-president, the Board of Directors includes the following: D. H. Ross, Ross Carrier Co.; R. C. Howell, Howell Industrial Truck Co.; W. F. Hobard, W. F. Hobard Co.

Metal-Working Code Hearings Scheduled

Date	Place	Deputy Administrator	Association
Dec. 6	Dept. of Commerce	H. O. King	Manufacturers of Railway Brass Car & Locomotive Journal Bearings and Castings
Dec. 6	Washington Hotel	Malcolm Muir	Beater, Jordan & Allied Equipment Manufacturers
Dec. 6	Washington Hotel	Malcolm Muir	Saw Mill Machinery Manufacturers
Dec. 6	Washington Hotel	Malcolm Muir	Manufacturers of Woodworking Machinery
Dec. 7	Willard Hotel	Malcolm Muir	Saw Manufacturers
Dec. 7	Washington Hotel	K. J. Ammerman	Automotive Parts in Equipment Manfacturers, Inc.
Dec. 7	Mayflower Hotel	R. W. Murray	National Commercial Fixture Manufacturers
Dec. 8	Mayflower Hotel	Malcolm Muir	Cereal Machinery
Dec. 8	Mayflower Hotel	Malcolm Muir	Hoisting Engine Manufacturer
Dec. 8	Mayflower Hotel	Malcolm Muir	Water Meter Institute
Dec. 8	Washington Hotel	W. A. Hanssen	American Zinc Institute, Inc.
Dec. 8	Willard Hotel	K. J. Ammerman	Emergency National Committee of the Maintenance & Garage Industry
Dec. 11	Willard Hotel	Malcolm Pirnie	Steel Joist Institute
Dec. 12	Mayflower Hotel	W. A. Janssen	Motorcycle Manufacturers.
Dec. 13	Commerce Bldg	W. A. Janssen	Bicycle Manufacturers.
Dec. 15	Burlington Hotel	Malcolm Muir	Stoker Manufacturers.

• BUSINESS ITEMS •

Plant and laboratory facilities of the Bronze Foundry Division, East Chicago, Ind. plant, The Superheater Co., have been extended to produce a full line of bronze castings, rough and finished, for use by other manufacturers. Standard bronzes, aluminum bronzes, and supertensile manganese bronzes will be produced.

The Atlantic Gear Works has moved its plant and office to New York City. The office is located at 128 Lafayette St., and the factory a few blocks distant. Increased floor space and the addition of new machinery are results of the move.

The National Association of Fan Manufacturers, founded in 1918, has opened an office at 5-208 General Motors Building, Detroit, Mich., for the purpose of coordinating its activities under NRA. L. O. MONROE is in charge.

The Morse Chain Co., Ithaca, N. Y., has acquired the "Kelpo" free-wheeling or one-way industrial clutch from the Kelpo Clutch Co., Rockford, Ill. FRED M. POTGIETER, formerly president of Kelpo, has joined the Morse organization.

• PERSONALS •

HARLOW H. CURTICE, general manager of the Buick Motor Co., has been made president.

C. A. BORTON, production manager of the Autocar Co., has been made vice-president, manufacturing division.

C. L. HALLIDAY is now plant manager, Eaton Mfg. Co., Jackson, Mich.

WILLIAM H. SYMONDS has been elected president and treasurer of the W. D. Allen Mfg. Co., Chicago, manufacturer of fire protection equipment and brass parts. Mr. Symonds succeeds T. L. RYERSON who died September 26. He was made vice-president of the company in 1931. CHARLES E. MENG has been made vice-president in charge of production.

WALTER E. PETERSON, formerly connected with the Magnolia Metal Co., is now manager of the babbitt metal department, Chicago plant, United American Metals Corp., and will devote particular attention to the introduction of babbitt metal in bushing form.

J. W. BRUSSEL has resigned as works manager of the Timken Detroit Axle Co.

• OBITUARIES •

Legge, Harvester Head, Dies

Alexander Legge, president of the International Harvester Co., died Dec. 3 from a heart attack that may have been induced by his recent long hours of work on the NRA code for his industry. Mr. Legge's health had been considered exceptionally good. He would have been 68 years old on Jan. 13.

With only a grade school education as a foundation, Mr. Legge rapidly won promotions with the Harvester company and achieved the following distinctions: head of the Federal Farm Board from 1929 to 1931, vice-chairman of the War Industries Board in charge of the Allied Purchasing Commission and later of the Requirements Division, and economic advisor to President Wilson during the peace negotiations in 1919.

DR. CONRAD V. HAHN, 43, associate professor of mechanical engineering, Drexel, Institute, Philadelphia, died Dec. 3. Dr. Hahn had been managing director of the Hahn Company, consulting engineers, and director and associate engineer of the International Development Company, Washington. He was a member of the Franklin Institute.

C. B. HOUCK, president of the Harrisburg Pipe Bending & Machine Co., and formerly general manager of the Wilkes-Barre & Hazelton Railway Co., died November 21.

ALBERT H. JARECKI, 81, vice-president of the Jarecki Mfg. Co., Erie, Pa., died November 23. He retired in 1903 from active participation in the company's business.

TILLMAN D. LYNCH, a past-president of the American Society for Steel Treating and formerly consulting metallurgical engineer for the Westinghouse Electric & Manufacturing Co., died November 27 at the age of 66.

LOUIS ALBERT SAFFORD, vice-president of the McQuary-Norris Manufacturing Co., St. Louis, Mo., died recently at Detroit. His age was 54. Mr. Safford was widely known in the automotive parts manufacturing and distributing fields.

FRED J. SKINNER, founder of the Skinner Manufacturing Co. Ltd., Canada, manufacturer of automobile bumpers, which was sold to the Houdaille Hershey Corp., died recently. Mr. Skinner was president of the Canadian branch of the organization.

NORBERT TRIMPE, 24, manager of the Cincinnati Machinery & Supply Co., was killed in an automobile accident recently. Mr Trimpe joined the company when he was 15 years old and learned the business so rapidly that he soon became manager. He was well known among the machinery dealers.

JOHN C. MOON, president of the Landis Machine Co., St. Louis, Mo., died November 21 at the age of 80.

• MEETINGS •

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual meeting, Dec. 4-8. Engineering Societies Bldg., New York, N. Y. ERNEST HARTFORD, assistant secretary, 29 West 39th St., New York, N. Y.

CHEMICAL EXPOSITION. Including machinery and equipment. Dec. 4-9. Grand Central Palace, New York. CHARLES F. ROTH, manager, International Exposition Co., Grand Central Palace, New York, N. Y.

SOCIETY OF AUTOMOTIVE ENGINEERS. Annual dinner, Jan. 8. Hotel Commodore, New York. Annual meeting, Jan. 22-25. Book-Cadillac Hotel, Detroit. JOHN A. C. WARNER, secretary, 29 West 39th St., New York, N. Y.

TAYLOR SOCIETY. Annual meeting, the American Marketing Society cooperating. Dec. 6-8. Hotel Pennsylvania, New York. H. S. PERSON, managing director, 29 West 39th St., New York, N. Y.

TAYLOR CELEBRATION. Stevens Institute of Technology, Hoboken, N. J., 10 A.M., Dec. 7. The American Society of Mechanical Engineers and the Taylor Society will cooperate. Metal cutting tests will be repeated Saturday morning, Dec. 9.

American Machinist
REFERENCE BOOK SHEET

American National Thread Standards

8-Pitch Thread Series

American National 8-Pitch Thread Series

Identification		Basic diameters			Thread data		
Sizes	Threads per inch	Major diameter, D	Pitch diameter, E	Minor diameter, K	Metric equivalent of major diameter	Helix angle at basic pitch diameter, ϑ	Basic area of section at root of thread, $\frac{\pi K^2}{4}$
1	2	3	4	5	6	7	8
		Inches	*Inches*	*Inches*	*mm*	*Deg. Min.*	*Square inches*
1 [1]	8	1.0000	0.9188	0.8376	25.400	2 29	0.5510
1⅛	8	1.1250	1.0438	.9626	28.575	2 11	.7277
1¼	8	1.2500	1.1688	1.0876	31.750	1 57	.9290
1⅜	8	1.3750	1.2938	1.2126	34.925	1 46	1.1548
1½	8	1.5000	1.4188	1.3376	38.100	1 36	1.4052
1⅝	8	1.6250	1.5438	1.4626	41.275	1 29	1.6801
1¾	8	1.7500	1.6688	1.5876	44.450	1 22	1.9796
1⅞	8	1.8750	1.7938	1.7126	47.625	1 16	2.3036
2	8	2.0000	1.9188	1.8376	50.800	1 11	2.6521
2¼	8	2.1250	2.0438	1.9626	53.975	1 7	3.0252
2¼	8	2.2500	2.1688	2.0876	57.150	1 3	3.4228
2⅜	8	2.5000	2.4188	2.3376	63.500	0 57	4.2917
2¾	8	2.7500	2.6688	2.5876	69.850	0 51	5.2588
3	8	3.0000	2.9188	2.8376	76.200	0 47	6.3240
3¼	8	3.2500	3.1688	3.0876	82.550	0 43	7.4874
3⅜	8	3.5000	3.4188	3.3376	88.900	0 40	8.7490
3¾	8	3.7500	3.6688	3.5876	95.250	0 37	10.1088
4	8	4.0000	3.9188	3.8376	101.600	0 35	11.5667
4¼	8	4.2500	4.1688	4.0876	107.950	0 33	13.1228
4⅜	8	4.5000	4.4188	4.3376	114.300	0 31	14.7771
4¾	8	4.7500	4.6688	4.5876	120.650	0 29	16.5295
5	8	5.0000	4.9188	4.8376	127.000	0 28	18.3802
5¼	8	5.2500	5.1688	5.0876	133.350	0 26	20.3290
5½	8	5.5000	5.4188	5.3376	139.700	0 25	22.3760
5¾	8	5.7500	5.6688	5.5876	146.050	0 24	24.5211
6	8	6.0000	5.9188	5.8376	152.400	0 23	26.7645

[1] Standard size of the American National coarse-thread series.

NOTE.—Pitch, $p=0.12500$ inch; depth of thread, $h=0.08119$ inch; basic width of flat, $p/8=0.01562$ inch; minimum width of flat at major diameter of nut, $p/24=0.00521$ inch.

New material added to the Report of the National Screw Thread Commission (revised 1933), includes specifications, reproduced here, of the 8-pitch thread in sizes from 1 to 6 in. The American National form of thread profile is used. One of the tables gives the nominal sizes and basic dimensions, whereas the other presents limiting dimensions and tolerances, classes 2 and 3 fits.

Bolts for high-pressure pipe flanges, cylinder-head studs and similar fastenings against pressure require that an initial tension be set up in the fastening, by elastic deformation of the fastening and the components held together, such that the joint will not open up when the steam or other pressure is applied. To secure a proper initial tension it is not practicable that the pitch should increase with the diameter of the thread, as the torque required to assemble the fastening would be excessive. Accordingly, for such purposes the 8-pitch thread has come into general use.

Limiting Dimensions and Tolerances, Classes 2 and 3 Fits, American National 8-Pitch Thread Series

Dimensions and tolerances [1]	Size (inches)																								
	1 [2]	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2¾	3	3¼	3½	3¾	4	4¼	4½	4¾	5	5¼	5½	5¾	6
BOLTS AND SCREWS	*Inch*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Classes 2 and 3, major diameter — Max	1.0000	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.3750	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000	4.2500	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
Min	.9848	1.1098	1.2348	1.3598	1.4848	1.6098	1.7348	1.8598	1.9848	2.1098	2.2348	2.3598	2.4848	2.7348	2.9848	3.2348	3.4848	3.7348	3.9848	4.2348	4.4848	4.7348	4.9848	5.2348	5.4848	5.7348	5.9848
Tol	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152	.0152
Classes 2 and 3, minor diameter — Max [3]	.8466	.9716	1.0966	1.2216	1.3466	1.4716	1.5966	1.7216	1.8466	1.9716	2.0966	2.2216	2.3466	2.5966	2.8466	3.0966	3.3466	3.5966	3.8466	4.0966	4.3466	4.5966	4.8466	5.0966	5.3466	5.5966	5.8466
Class 2, pitch diameter (for general use) — Max	.9188	1.0438	1.1688	1.2938	1.4188	1.5438	1.6688	1.7938	1.9188	2.0438	2.1688	2.2938	2.4188	2.6688	2.9188	3.1688	3.4188	3.6688	3.9188	4.1688	4.4188	4.6688	4.9188	5.1688	5.4188	5.6688	5.9188
Min	.9112	1.0338	1.1563	1.2813	1.4038	1.5313	1.6538	1.7788	1.9013	2.0313	2.1538	2.2788	2.4013	2.6538	2.9038	3.1538	3.4063	3.6538	3.9063	4.1513	4.4038	4.6513	4.9038	5.1538	5.4063	5.6538	5.9063
Tol	.0076	.0079	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063	.0063
Class 3, pitch diameter — Max	.9188	1.0438	1.1688	1.2938	1.4188	1.5438	1.6688	1.7938	1.9188	2.0438	2.1688	2.2938	2.4188	2.6688	2.9188	3.1688	3.4188	3.6688	3.9188	4.1688	4.4188	4.6688	4.9188	5.1688	5.4188	5.6688	5.9188
Min	.9134	1.0383	1.1630	1.2877	1.4125	1.5373	1.6620	1.7868	1.9115	2.0363	2.1611	2.2861	2.4106	2.6601	2.9096	3.1586	3.4086	3.6586	3.9083	4.1582	4.4081	4.6580	4.9080	5.1580	5.4086	5.6587	5.9086
Tol	.0054	.0055	.0058	.0061	.0063	.0065	.0068	.0070	.0073	.0073	.0077	.0082	.0082	.0087	.0092	.0102	.0102	.0102	.0105	.0106	.0097	.0098	.0080	.0080	.0100	.0101	.0102
NUTS AND TAPPED HOLES																											
Classes 2 and 3, major diameter — Min [4]	1.0000	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.3750	2.5000	2.7500	3.0000	3.2500	3.5000	3.7500	4.0000	4.2500	4.5000	4.7500	5.0000	5.2500	5.5000	5.7500	6.0000
Classes 2 and 3, minor diameter — Min	.8647	.9897	1.1147	1.2397	1.3647	1.4897	1.6147	1.7397	1.8647	1.9897	2.1147	2.2397	2.3647	2.6147	2.8647	3.1147	3.3647	3.6147	3.8647	4.1147	4.3647	4.6147	4.8647	5.1147	5.3647	5.6147	5.8647
Max	.8796	1.0032	1.1282	1.2532	1.3782	1.5063	1.6282	1.7532	1.8782	2.0032	2.1282	2.2782	2.3782	2.6282	2.8782	3.1282	3.3782	3.6282	3.8782	4.1282	4.3782	4.6282	4.8782	5.1282	5.3782	5.6282	5.8782
Tol	.0149	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135	.0135
Classes 2 and 3, pitch diameter — Min	.9068	1.0438	1.1688	1.2938	1.4188	1.5438	1.6688	1.7938	1.9188	2.0438	2.1688	2.2938	2.4188	2.6688	2.9188	3.1688	3.4188	3.6688	3.9188	4.1688	4.4188	4.6688	4.9188	5.1688	5.4188	5.6688	5.9188
Class 2, pitch diameter (for general use) — Max [5]	.9264	1.0517	1.1771	1.3024	1.4278	1.5531	1.6785	1.8038	1.9292	2.0545	2.1798	2.3051	2.4305	2.6812	2.9318	3.1825	3.4331	3.6837	3.9323	4.1825	4.4326	4.6827	4.9328	5.1828	5.4330	5.6831	5.9332
Tol	.0076	.0079	.0082	.0086	.0090	.0093	.0097	.0098	.0094	.0097	.0101	.0127	.0127	.0127	.0130	.0132	.0133	.0134	.0135	.0137	.0138	.0139	.0140	.0141	.0142	.0143	.0144
Class 3, pitch diameter — Max [5]	.9242	1.0493	1.1745	1.2995	1.4251	1.5503	1.6756	1.8006	1.9261	2.0513	2.1765	2.2270	2.4775	2.6282	2.9280	3.1781	3.4281	3.6783	3.9283	4.1784	4.4285	4.6785	4.9287	5.1787	5.4286	5.6789	5.9290
Tol	.0054	.0055	.0058	.0061	.0063	.0063	.0068	.0070	.0073	.0073	.0077	.0082	.0082	.0087	.0092	.0092	.0092	.0094	.0086	.0096	.0097	.0098	.0098	.0099	.0100	.0101	.0102

[1] Pitch diameter tolerances include errors of lead and angle. The class 2 tolerances are based on the formulas in table 60 and a length of engagement equal to the basic major diameter for sizes from 1¼ to 3 inches, inclusive, and a length of engagement of 3 inches for sizes over the 3-inch. The class 3 tolerances are 70 percent of the class 2 tolerances. The 1-inch size being in the American National coarse-thread series, the tolerances for this size correspond to that series.

[2] Standard size screw and nut of the American National coarse-thread series.

[3] Dimensions given for the maximum minor diameter of the screw are figured to the intersection of the worn tool arc with a center line through crest and root. The minimum minor diameter of the screw shall be that corresponding to a flat at the minor diameter of the minimum screw equal to $\frac{1}{8} \times p$, and may be determined by subtracting 0.0812 inch from the minimum pitch diameter of the screw.

[4] Dimensions for the minimum major diameter of the nut correspond to the basic flat ($\frac{1}{4} \times p$), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the nut shall be that corresponding to a flat at the major diameter of the maximum nut equal to $\frac{1}{16} \times p$, and may be determined by adding 0.0902 inch to the maximum pitch diameter of the nut.

[5] These dimensions are the minimum metal or "not go" size. The "go" or basic size is the one that should be placed on the component drawing with the tolerance.

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• IDEAS FROM PRACTICAL MEN

Milling Fixture for Plate Cams

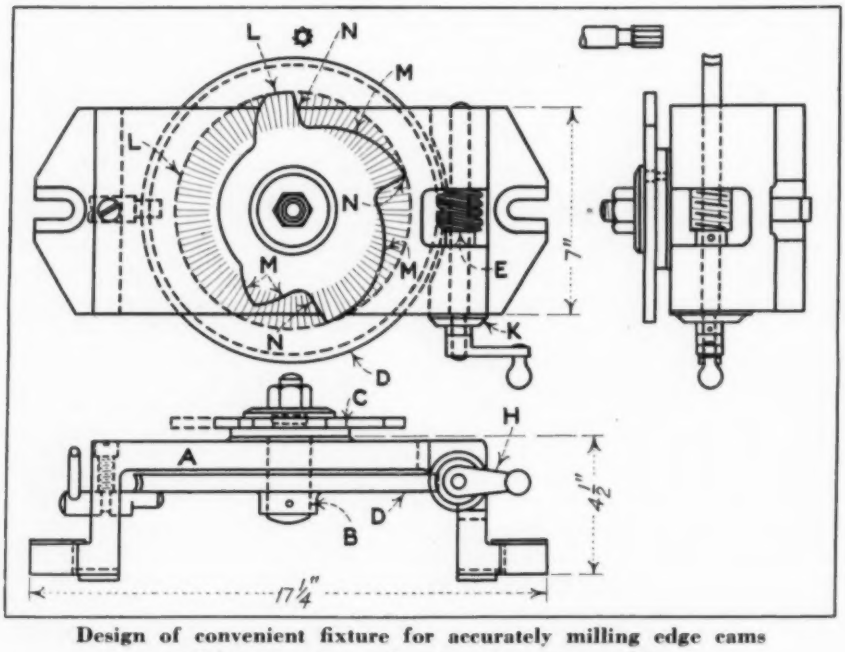
H. THORNTON

In their many applications to machine function, cams assume many sizes and shapes, perhaps the most familiar being the plate cams used in the small, automatic screw machine.

The illustration represents a fixture designed to facilitate the milling of plate cams in general and displays the outlines of a cam for use in the automatic screw machine. Essentially it consists of the base *A* in the form of a bridge; the work spindle *B*, having a large shoulder at *C;* the wormwheel *D;* the worm *E;* the indexing crank *H;* and the micrometer dial *K*. In accord with the usual practice of dividing cam blanks into radial divisions for plotting, the wormwheel has the same number of teeth as the radial divisions. While one revolution of the indexing crank rotates the work one of these divisions, fractional parts of a division are indicated by the micrometer dial.

Following the usual method of plotting the diagram on the blank, drilling a hole for the driving pin, and removing the excess metal outside of the diagram, the blank is located on the work spindle and is clamped against the shoulder by a nut. Normally, the center line of the fixture coincides with that of the cutter, and in milling the concentric portions *L*, the blank is fed toward the cutter until its cutting edge coincides with the outline, the indexing crank being simply turned to rotate the blank.

In milling the lobes *M*, each movement of the indexing crank makes a radial shift of the blank, the blank making separate contact with the cutter at each indexing for the progressive outline or contour. For milling the sharp rises and falls, as at *N*, the table is moved to bring the face of the cutter coincident with the center line of the blank, so as to better tangent the face *N* to the side-cutting action of the cutter. This position is shown in the drawing. In feeding the blank to contact with the cutter, the indexing crank can be fractionally turned so as to produce a drop that is other than a straight radial line, according to the diagram. The practiced operation of the indexing crank affords a convenient means for rotating the blank in either direction while the cutter is at work. The usual file finish completes the job.



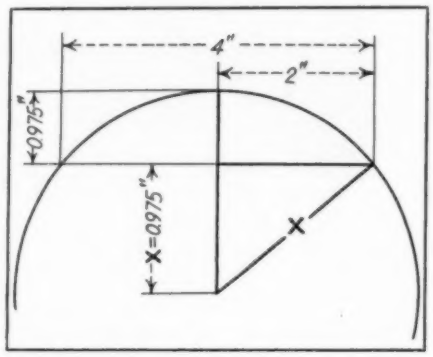
Design of convenient fixture for accurately milling edge cams used in some types of automatic screw machines

Finding the Diameter Where the Center Is Not Accessible
Discussion

JOHN ROLL

Mechanical Engineer, The Singer Manufacturing Company

Referring to the articles under the title given above by Paul C. Bruhl and George Belbes (*AM*—Vol. 77, pages 184 and 636, respectively), I would like to submit what I believe to be a much



simpler method for solving the problem. Referring to the sketch:

$X^2 = 2^2 + (X - 0.975)^2$

$X^2 = 4 + X^2, - 1.950\ X + 0.950625$

$1.950\ X = 4.950625$

$X = 2.53878 =$ Radius

Diameter $= 2 \times 2.53878 = 5.07756$

It will be noticed that in this solution, no tables with their inherent errors are used, so that I believe the results are more accurate.

CHARLES KUGLER

I have read with interest the articles under the title given above by Paul C. Bruhl and Emil Wittmann (*AM*—Vol. 77, pages 184 and 571 respectively). I was particularly interested because I have had considerable experience in problems of the kind.

Whether the fragment is a disk or a gear, the diameter of the whole can be found in the following way: Stand the fragment on its face on a flat plate, place two pieces of drill rod in the plate in contact with the face of the fragment, as shown in the illustration, and fasten them to the plate with a few drops of solder. Remove the fragment and measure the distance across the pieces of drill rod with a micrometer.

Let A = the micrometer measurement across the pieces of drill rod.

r = the radius of the drill rod.

R = the radius of the whole disk or gear, and

$$B = \frac{A - 2r}{2}, \quad \text{then } R = \frac{B^2}{4r}.$$

Since lines drawn through the points *CDF* form a right-angle triangle, the formula can be proved as follows:

$$(CF)^2 = (CD)^2 + (DF)^2$$

and $CF = R + r$

$CD = R - DE$, or $CD = R - r$

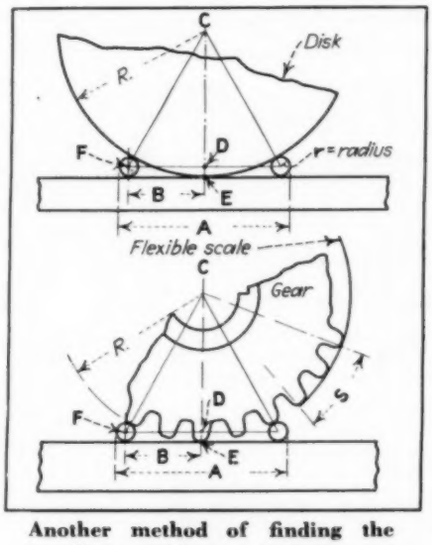
$(R + r)^2 = (R - r)^2 + B^2$

$R^2 + 2Rr + r^2 = R^2 - 2Rr + r^2 + B^2$,

therefore

$$4Rr = B^2 \text{ and } R = \frac{B^2}{4r}.$$

If the fragment is that of a gear, having found the diameter of the whole by multiplying the radius by two, the diametral pitch can be found by placing the fragment on such a gear chart as can be found in the Brown & Sharpe small-tool catalog. Having these two items, all other data can be calculated. In the absence of a gear chart, two points, such as are included in the



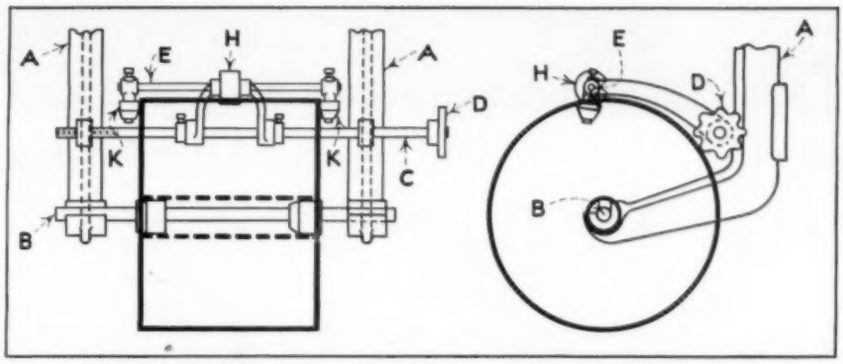
Another method of finding the diameter from a fragment

dimension *S*, are selected at random and are measured with a flexible scale, and the number of teeth between them is counted.

Let H = the circumference of the gear.
S = the distance between the two points on the periphery.
F = the number of teeth in the distance S.
W = the ratio between the circumference and the distance S.

Then $H = W$, and $W \times F =$ the number of teeth in the whole gear, because the ratio between the circumference of the gear and the distance *S* is the same as that between the number of teeth in the distance *S* and the number of teeth in the gear. With the outside diameter of the gear and the number of teeth known, all other data can be easily found.

This method will be found very useful in job shops which replace broken gears.



Guiding roll strip stock and keeping it under tension. This device is adjustable for various widths of material

Guiding Strip Stock as It Is Being Fed from Rolls

F. SERVER

The object of the device illustrated is to control the sidewise position of strip stock as it is being fed from rolls to press tools. Since the control mechanism is at the periphery of the roll of stock any irregularities in the position of the stock on the roll are automatically compensated for thereby providing an accurate sidewise alignment as it is being fed.

Referring to the illustration the brackets *A* are attached to the machine proper and carry the shaft *B*. The roll of stock is mounted on this shaft being carried on two hubs or spools and is unrolled from the under side. The threaded rod *C* is controlled by a hand knob and carries a pair of arms positioned thereon by collars. Another rod *E* is provided to hold the outer ends of the arms in alignment and on which is mounted the roller *H* resting on the roll of stock. The combined weight of this roller and the arms acts as a brake on the stock.

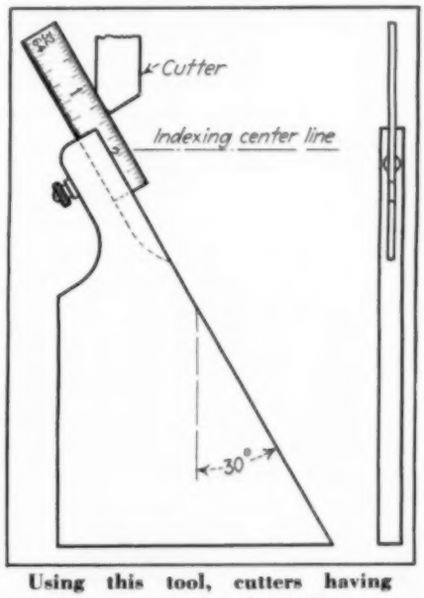
For guiding the roll of stock sidewise, two small rollers *K*, mounted on studs attached to supporting members, are carried on the rod *E*. These rollers revolve in unison with the roll of stock by friction and are tapered on their lower ends so as to lead a fresh roll of stock into alignment when it is placed in the machine. If the stock is not being correctly aligned as it is fed into the machine, a sidewise adjustment is made by turning the threaded rod *C* by the hand knob *D*, moving the rollers *K* and the roll of stock into the correct position.

Cutters for Fluting Taps and Reamers—*Discussion*

MARTIN H. BALL

Referring to the article under the title given above by Matthew Harris (*AM*—Vol. 77, page 635), the tool illustrated provides a means of setting standard cutters for fluting taps and reamers, both for depth and for offsetting the proper amount to produce radial cutting faces on the tools.

In using the tool, the scale is adjusted to bring one of the even inch graduations to the height of the index centers when the base is resting on the table, as indicated by the indexing center line in the drawing. With the gage in this position, the table can be adjusted to height and also laterally



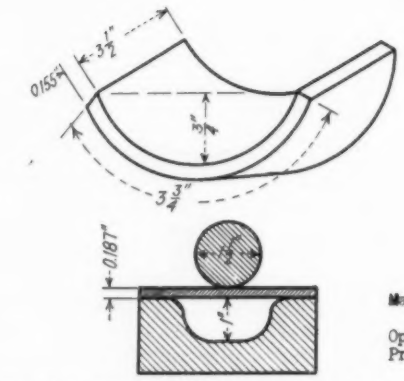
Using this tool, cutters having backs at an angle of 30 deg. can be set to produce radial cutting faces on taps and reamers

until the cutter is at the correct depth for the cut. The depth of cut can be readily read from the scale by observing the graduation that is in line with the bottom of the cutter. Thus the setting is simplified.

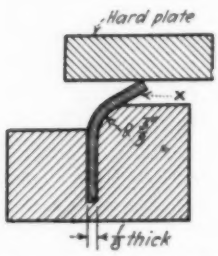
For the finishing cut, the reading, starting from the even inch mark to which the index center is set, should be one-half the diameter of the tool at the bottom of the flutes. The scale is one that is commonly in diemaker's squares.

Press Work Pressures

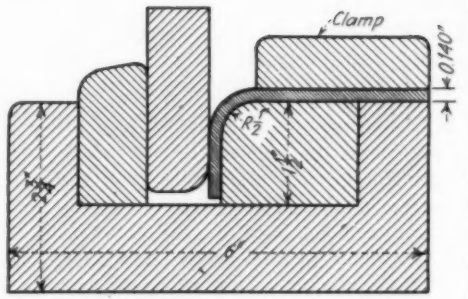
Series XXII—*Forming*



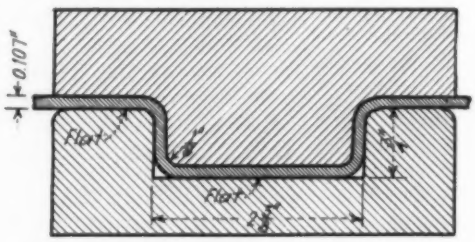
Material--Machine steel sheet, unannealed
A. 0.155 in. thick by 3-1/2 by 3-3/4 in.
B. 0.187 " " " "
Operation--Form as shown
Pressure--A. 6,000 lb. B. 10,000 lb.



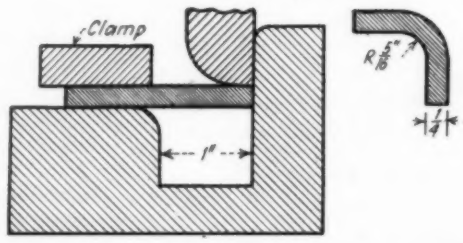
Material--Low-carbon steel, 1/8 in. thick
A. 1 in. wide B. 2 in. wide
Operation--Form as at X
Pressure--A. 350 lb. B. 700 lb.



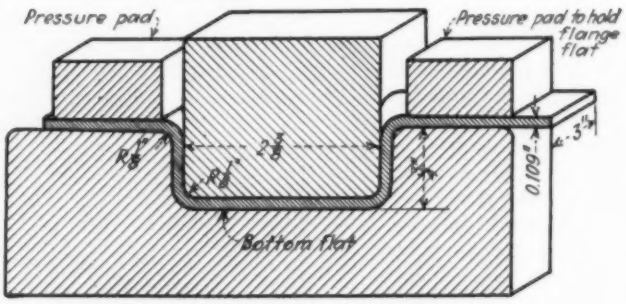
Material--Machine steel,
A-0.140 in. thick by 2 in. wide
B-0.140 in. thick by 3 in. wide
Operation--Form an angle of 90 deg. with a radius of 1/2 in.
Pressure--A-2,200 lb.
B-3,300 lb.
Test made in testing machine



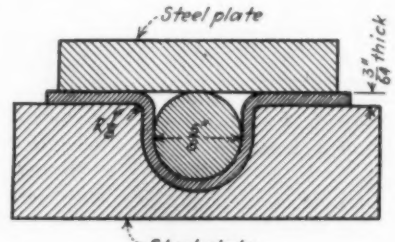
Material--Machine steel, 0.107 in. thick by 3 in. wide
Operation--Formed cold
Pressure--24,600 lb.



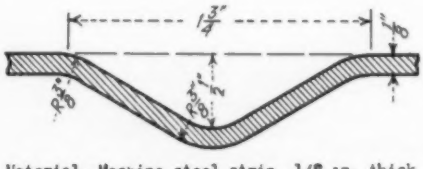
Material--Machine steel, 1/4 in. thick by 2 in. wide
Operation--Form an angle with a radius of 5/16 in.
Pressure--6,400 lb.



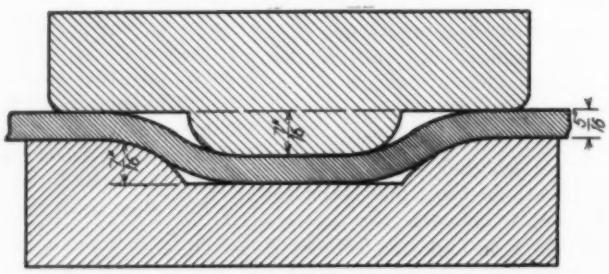
Material--Machine steel, 0.109 in. thick by 3 in. wide
Operation--Forming a piece of machine steel of practically the same dimensions as figure above. In this case forming was done by using pressure pads to hold the flange flat. (Same as a double-action die).
Pressure--24,600 lb.



Material--Machine steel, 3/64 in. thick by 1 in. wide
Operation--Form as shown
Pressure--7,000 lb.



Material--Machine steel strip, 1/8 in. thick by 3 in. wide
Operation--Form as shown
Pressure--14,000 lb.



Material--Machine steel, 5/16 in. thick by 2 in. wide
Operation--Form as shown, cold
Pressure--35 tons
50 tons for a strip 3 in. wide

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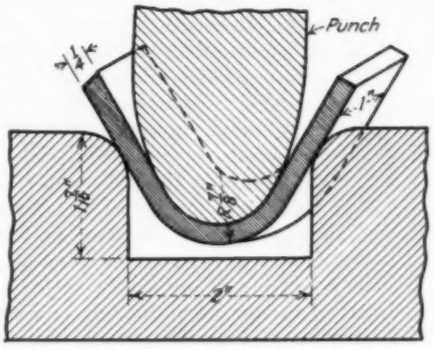
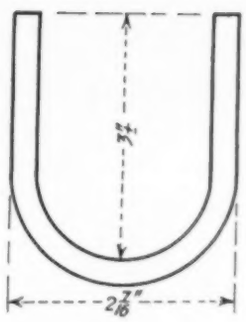
Press Work Pressures

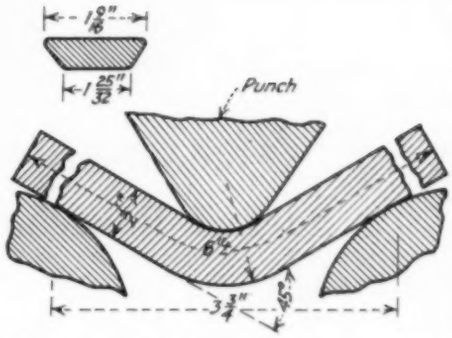
Series XXII—*Forming*



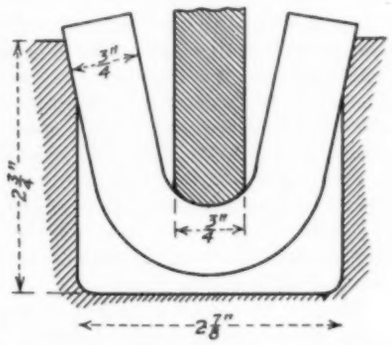
Material--Machine steel
A. 1/4 thick by 1 in. wide
B. 1/4 thick by 2 in. wide
Operation--Form cold
Pressure--A. 4,000 lb. B. 8,200 lb.



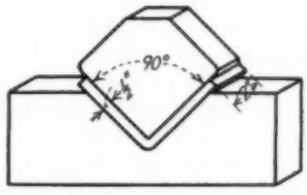
Material--Low-carbon steel strip, 0.090 in. thick by 1 in. wide
Operation--Form cold
Pressure--300 lb.



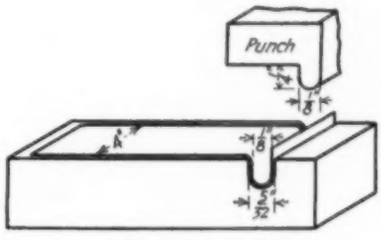
Material--Machine steel, unannealed
A. 1/2 in. thick by 3/4 in. wide
B. 1/2 in. thick by 1-1/2 in. wide
Operation--Bend as shown
Pressure--A. 3,200 lb.
B. 7,200 lb.



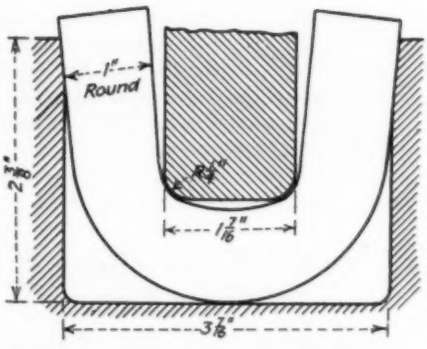
Material--Machine steel, 3/4 in. thick by 3 in. wide
Operation--Form as shown
Pressure--16 tons



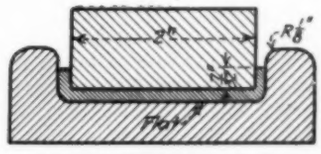
Material--Steel, 1/2 in. thick by 2 in. wide
Operation--Form a 90-deg. angle
Pressure--47-1/2 tons



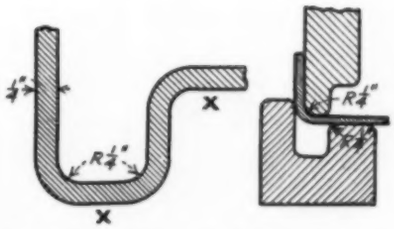
Material--Tin strip, 0.014 in. thick by 4 in. wide
Operation--Form as shown
Pressure--1,000 lb.



Material--Machine steel, 1 in. in diameter
Operation--Form as shown
Pressure--14 tons

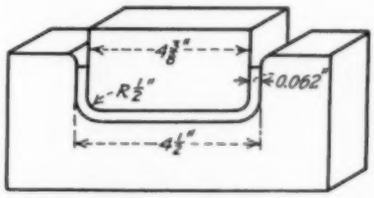


Material--Machine steel, 1/8 in. thick by 4 in. wide
Operation--Form as shown
Pressure--34,000 lb.

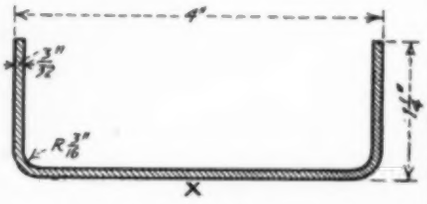


Material--Machine steel, 1/4 in. thick by 1-1/4 in. wide
Operation--Form as shown
Pressure--17 tons to form, 25 tons to flatten at x-x

Material--Decarbonized steel, 0.062 in. thick by 1 in. wide
Operation--Form the two ends with the bottom flat
Pressure--3,500 lb.



Material--Machine steel, 0.062 in. thick
A. 1 in. wide
B. 3 in. wide
Operation--Form ends
Pressure--A. 300 lb. B. 1,100 lb.



Material--Machine steel, 3/32 in. thick by 1 in. wide
Operation--A. Bottom at X slightly curved
B. Bottom flat by means of spring pad in lower die
Pressure--A. 4,000 lb. B. 4,500 lb.

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SHOP EQUIPMENT NEWS

Foote-Burt Horizontal Surface Broaching Machine

Horizontal construction of a line of surface broaching machines offered by the Foote-Burt Co., Cleveland, Ohio, is responsible for high production because of rapid loading and unloading. This type of machine lends itself to the use of an unusually long broach which provides many teeth for removing the metal and makes possible almost any desired quality of finish. A slow cutting speed of 25 ft. per min. provides economical broach life, the broach averaging about 50,000 cuts per grind. Three sizes of this machine are available as follows: No. 5 with a capacity of 5 hp. and a maximum broach length of 30 in.; No. 10 with a capacity of 10 hp., and a maximum broach length of 60 in., and No. 15 with a capacity of 20 hp., and a broach length of 75 in.

Since the nature of any surface broaching operation requires a rigid and heavy machine, this machine has a bed of the box type, heavily ribbed and cast in one piece. Smooth drive to the chain carrying the work fixtures is assured by transmitting power from the motor through a worm and worm gear reduction and then through a helical gear reduction to the driving sprocket. The chain is accurately constructed so that the work-holding fixtures may be assembled directly to it. The number of fixtures furnished is governed by the production desired and the size of the work. The fixtures are always placed equidistant along the chain for convenience in loading.

The fixture tunnel on the top of the bed has tool-steel guides and provides solid support during broaching. The broach holder is made with adjustable wedges that provide a method of setting the broaches to the cut and also an easy means of compensation for the amount of metal removed when the broaches are reground. Usually the fixtures are of the automatic clamping type. The operator merely drops the work into the fixtures and a cam guide equalizes the work in the proper position. The fixture is locked automatically by means of a trip hammer blow.

After the fixtures pass through the broach cut, they are released automatically by a cam at the unloading position and the work falls into a chute. The accompanying illustration shows the operator's loading position. The fixture exposed holds a connecting-rod cap which is placed in the fixture so that it will rest upon the two steel buttons which contact with the two back bolt bosses. A vise type fixture is employed, the drive side of the jaw being the solid part of the fixture and acting as a heavy anvil support to the work. The other jaw is movable, being actuated by a wedge with a fast angle followed by a slow angle for locking the cap sidewise.

Coolant is pumped through jets for the entire length of the broach holder. Chips are washed free from the teeth of the broach and down through cored openings into the lower portion of the bed. On the larger machines a conveyor carries the chips out of the machine. When grinding the broach, the sections are removed from the holder and placed in a surface grinder. About 0.002 in. of metal is removed from the top of the teeth. The teeth should be slightly backed off for clearance.

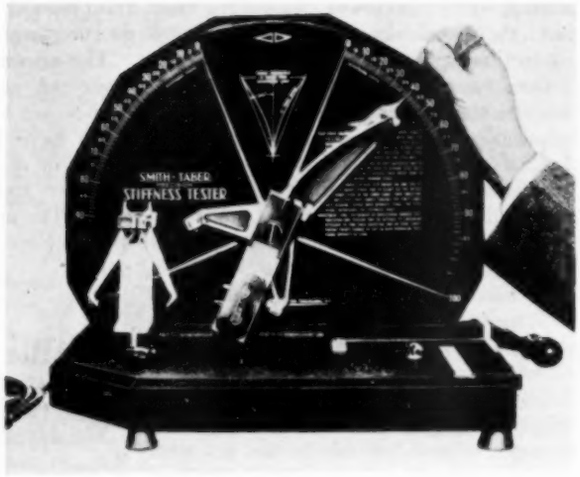
Besides the regular push button station for starting and stopping, the machine has a special plugging switch so the operator can stop the machine instantly. Coupled with these switches is an automatic plugging switch which is placed in front of the broach so that should the operator be careless in placing the work in the fixtures, the uneven position of the work will cause it to strike the guard, which will plug the motor and stop the machine.

Foote-Burt Horizontal Surface Broaching Machine set up for removing 3/16 in. of metal from the two joint faces and the two outer end surfaces of a connecting-rod cap. Production, 1,800 pieces per hr.

Smith-Taber Model E Stiffness Tester

Determining the effect of thickness and temper on the stiffness of wire and thin sheet is the function of a testing equipment manufactured by Smith-Taber, North Tonawanda, N. Y. Filaments from the finest size up to 0.050 in. in diameter and sheet from the thinnest foil to materials 0.010 in. thick may be tested.

Sensitivity and design of the instrument make possible accurate measurements of the plastic flow that takes place within a deflected specimen. This enables the elastic or spring-like prop-



Thin sheet and fine wire can be tested in 3 to 30 min. for stiffness on the Smith-Tabor Model E Testing Machine

erties of materials to be analyzed. This flow characteristic makes necessary a division of the terms stiffness to "initial stiffness" and "basic stiffness" and the injection of the time element. Basic stiffness is determined by following the initial reading with others taken at 3-min. intervals until the plastic flow has practically ceased. The specimen remains bent at the standard angle throughout the duration of the test. The stiffness usually becomes stabilized within 3 to 30 min. Tungsten-steel contact points prevent stressing the specimen beyond the standard 22½-deg. angle and form a contact that flashes a brilliant signal the moment the full bend occurs.

In operation the test strip is placed in the clamp at the upper end between V guides and a thumb screw is tightened. The indicator arm is moved steadily across the scale and the reading is taken at the point indicated by the pilot light. The operation is repeated over the opposite scale. The totalized result represents the stiffness of the specimen. New features include: a bimetal pendulum suspended on double ball-bearings, a twin weight for increasing the capacity of the pendulum from 200 to 2,000 units, and a counter-balanced operating lever with adjustable preloading brake in hub.

Porter-Cable No. 6 Attachment for Milling Machines

A fully universal, high-speed No. 6 attachment for power feed milling machines has been developed by the Porter-Cable Machine Co., Syracuse, N. Y. The attachment is held rigidly by the overarm clamp regardless of the position of the cutter. The attachment is driven by the spindle of the milling machine to provide a spindle speed 2½ times the speed of the milling machine spindle. Adaptable to any make of single or double overarm milling machine, the unit is furnished with either a No. 9, 10, or 11 B. & S. taper drive arbor. The spindle of the attachment itself has a No. 7 B. & S. taper for milling cutters of any description. For holding small end mills a split draw-in collet can be furnished. Weight of the attachment without the supporting clamp is 48 lb., and the weight of the clamp is 25 lb.

"Hi-Eff" Static Balancing Machines

For the balancing of flywheels, pulleys, pump impellers, gears and similar parts, the Taylor Manufacturing Corp., 2330 West Clybourn St., Milwaukee, Wis., is offering a series of "Hi-Eff" static balancing machines. These units are universal in use by enabling the balancing of various-shaped or sized parts in quick succession without a change in set-up. For example, any number of a certain flywheel can be balanced, followed immediately by one or a number of pulleys, clutch faces or gears of different size and weight. The only adjustment required is a turn or two, by the fingers, of the threaded portion of the centering spindle. This adjusts the weighing fulcrum to the center of gravity of the part to be balanced.

Unbalance can be corrected to 0.01 in. oz. on the smaller models to 0.1 in. oz. on the largest. Standard models are built to handle parts as light as one ounce and as small as one inch outside diameter whereas larger sizes will handle parts up to 48 in. in diameter and weighing up to 600 lb.

Location of the heavy spot is obtained through the use of a very sensitive spirit level. Weighing of the unbalance is accomplished either by a hand-operated weighing beam or through an automatic weighing dial. After the amount of unbalance has been determined, the usual delay in calculating the number of holes to be drilled and their

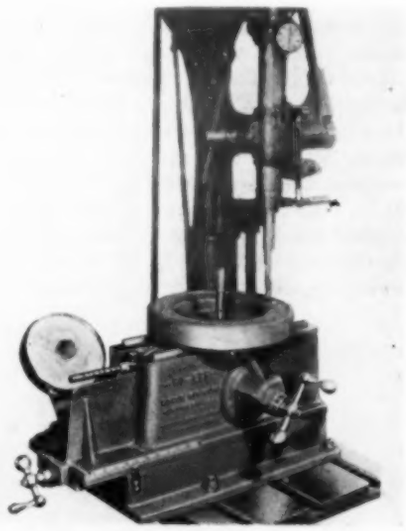
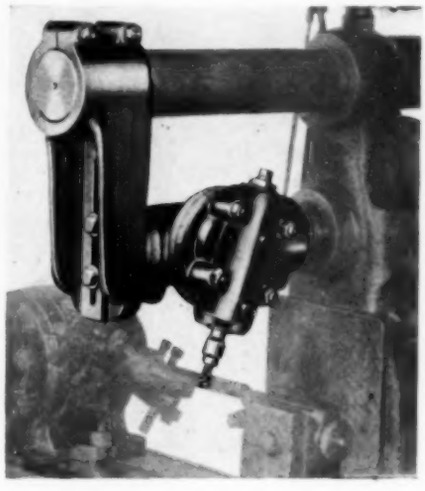


Fig. 1—"Hi-Eff" Static Balancing Machine with automatic calculator for number of holes and depth to be drilled



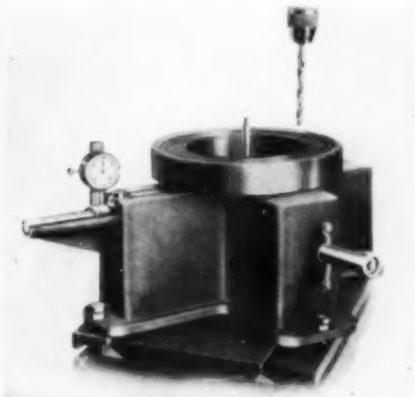


Fig. 2—"Hi-Eff" Machine of the lever type for light parts

depth is done away with automatically on the automatic calculator shown on the left of the machine in Fig. 1. By setting the indicator on a line for the inch ounces of unbalance the number of holes and their depth is read off the calculator for the particular point at which the drilling is to be done. If the particular spot where the excess material is to be removed should prove to be a hard spot, a turn of the left ballcrank will move the part in or out to a new position and the automatic calculator, moving in synchronism with the base, registers automatically the drilling data for the new position.

The part is placed on the base with the centering spindle through the bore of the part. A turn of the right ballcrank lifts the part into the balancing position and the heavy spot tilts the part, the bubble in the spirit level going to the opposite side. The heavy side is then swung in the cradle to a point opposite the weighing beam and the unbalance is weighed in inch ounces or decimals hereof. By turning the left ballcrank the part is moved so that the drill will come directly over the spot where the excess material is to be removed.

Various models of this balancing equipment can be used on any available drill press, and production-line models are built with integral base and drillhead. Models for balancing lightweight parts are of the lever type as shown in Fig. 2 and can be had for use on any drill press or in production-line models.

Hauser No. 3½ Jig Boring Machine

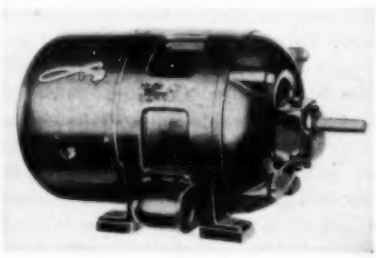
The Index Machinery Corp., 49 Central Ave., Cincinnati, Ohio, is introducing in the United States a No. 3½ "Hauser" jig boring machine built by Henry Hauser Co., Bienne, Switzerland. This machine has a working surface of 26x16 in., and the maximum distance between the table and nose spindle is 20 in. Maximum distance between the vertical columns is 24 in.; diameter of the circular table, 15¾ in.; maximum boring depth, 5½ in.; maximum drilling capacity, 1 in.; maximum boring capacity, 4 in.

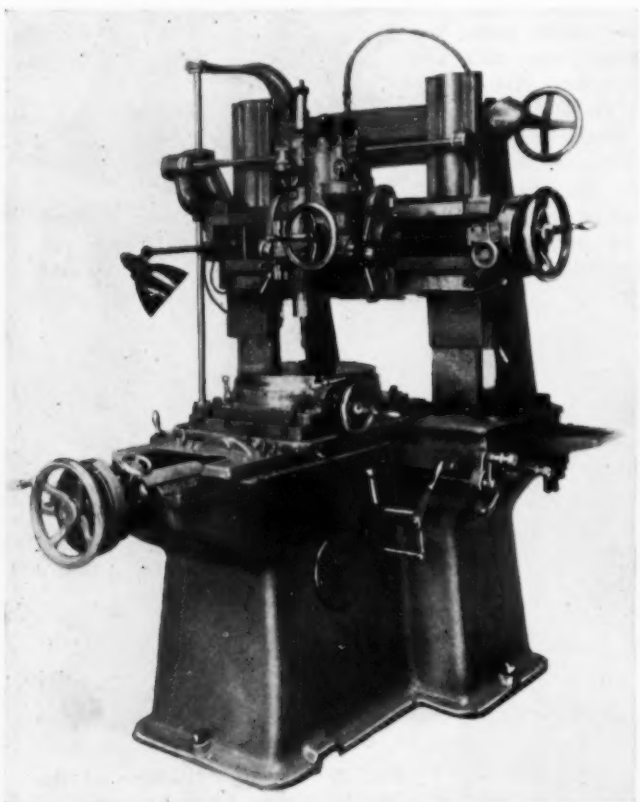
Alignment between the boring spindle and the work table is established, as shown in Fig. 2, by equipping the crossrail with hardened, ground and lapped locating plungers, which rest on hardened, ground and lapped locating blocks mounted on the housing members. The bearing contact is made at the outer end of the crossrail. No wear takes place through this method of locating the crossrail and no weight is suspended on the elevating screws.

The micrometer dials and verniers are made of stainless steel. Micrometer screws are relieved of strain after the slides have been positioned. Universal inclinable or plain circular tables as well as other special attachments are available. The machine is driven by a standard one-speed motor or by a single pulley.

Allis Self-Contained Capacitor Motor

The Louis Allis Company, Milwaukee, Wis., is introducing a line of single-phase, capacitor-start motors using a built-in capacitor and an automatic cut-out switch. The capacitor is located so that a stream of cooling air passes between the motor and capacitor constantly and so that motor heat is not radiated to the capacitor. Sizes available range from ⅓ to 3 hp. in either horizontal or vertical types.





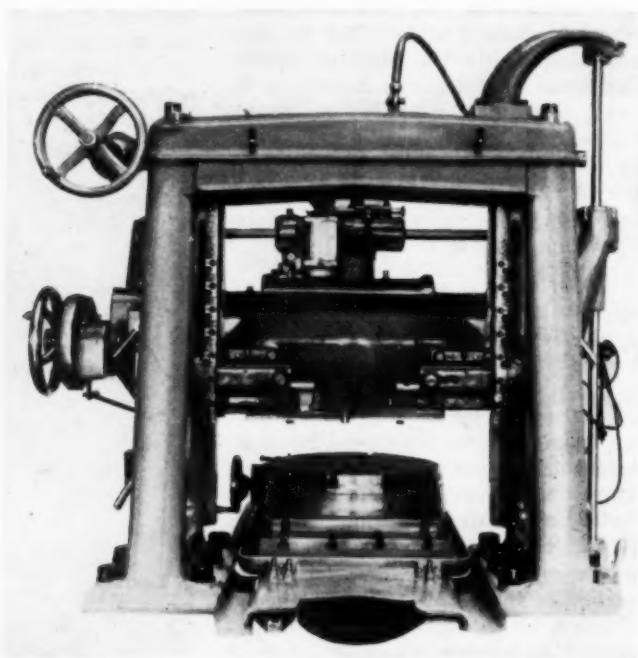


Fig. 1—Hauser No. 3½ Jig Boring Machine of the crossrail type and having working surface of 26 x 16 in. Fig. 2—Alignment betwen spindle and table is secured by locating blocks on housings and locating plungers on crossrail

Société Genevoise Profile Projector

The R. Y. Ferner Co., Investment Bldg., Washington, D. C., American agent for the Société Genevoise d'Instruments de Physique, Geneva, Switzerland, is marketing a profile projector which projects from below onto a heavy glass screen set in the top of a steel cabinet. The screen is set at a convenient angle for examination or measurement of the profile by an operator standing before the cabinet. Furthermore, the projection outlined can be used for tracing the design of any small article of which no drawing is available. It is also possible to take a photograph or make a photographic print of the profile.

A plain center support and an inclinable center support, each 5 in. between centers and 2⅞ in. swing, are furnished. The latter permits mounting and setting screws, taps or milling cutters inclined at their helical angle to give a horizontal cross-section of the profile of the thread. Another support with one center is designed for small milling cutters of the same maximum diameter. A fourth attachment has inclinable V-supports for screws and parts without centers and another provides for small pinions of watches. Other accessories include a table for making measurements in rectangular coordinates; an adjustable protractor sliding along a guiding ruler for use in drawing; and glass scales graduated to half millimeters or 0.02 in. for checking the profile roughly, or graduated to tenths of a millimeter or to 0.005 in. for making more exact measurements with the aid of a magnifying glass. Such measurements can be made to 0.01 in. or 0.005 in., which is equivalent to 0.0001 in., or 0.00005 in. on the object when using the objective giving a magnification of 100 times. Four objectives are furnished giving magnifications of 10 to 100 times. For focusing the image the object table is adjustable in height by fast and fine motion devices.

A table carrying the object is placed on a glass plate 2⅜ in. in diameter and mounted in a circle that can be rotated while at the same time it is moved in the two horizontal ordinates by a compound slide. This mounting permits quick centering of the article or the placing of its image in coincidence with a drawing or reference marks on the screen. For focusing the image the object table is adjustable in height by means of fast and fine motion devices. The table is about 5 in. above the surface of the screen and just behind it so the operator can place the article in correct position while sitting in front of the cabinet. Useful area of the glass screen is 4½x15¾ in. so that with the objective giving 100 times magnification the maximum size of the object is ⅛x⅝ in. Articles as large as 1¼x1⅞ in. may be projected with the 10-power objective.

Mercury "Banty" Industrial Tractor

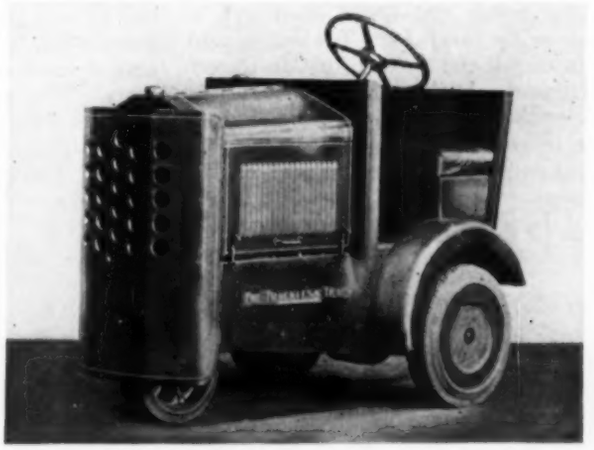
Weighing 2,700 lb., the "Banty" gas-powered tractor, now placed on the market, is the smallest of the line manufactured by the Mercury Manufacturing Co., 4130 S. Halstead St., Chicago, Ill. Overall dimensions are: length 73½ in.; width, 40 in. and turning radius, 54½ in. Maximum drawbar pull is 2,000 lb. at a speed of 2.5 m.p.h. Engine, clutch, transmission and rear axle are assembled as a unit, without drive shafts or couplings, to give a compact and sturdy mechanism. Welded steel plate frames and bumpers inclose the working parts. The tractor can be utilized for hauling industrial trains.

"Hercules" No. 61 High Frequency Grinder

The Buckeye Portable Tool Co., Dayton, Ohio, has just placed on the market the No. 61 high-frequency electric grinder built in two speeds, 3,800 r.p.m. for use with 6 in. vitrified emery wheels, and 5,400 r.p.m. for use with 6-in. elastic-bonded emery wheels. The 3,800 r.p.m. tool can also be used with 8-in. elastic-bonded wheels.

Features of these tools are the cool-running motor, the stream-line ventilation system and the mounting of the

Société Genevoise Profile Projector which projects onto a glass screen in the table top



"Banty" Industrial Tractor has drawbar pull of 2,000 lb. at 2.5 m.p.h., but weighs only 2,700 lb.

Cool-running motor and streamline ventilation adapt Hercules No. 61 Grinder to continuous duty

stator on insulating pads within the motor housing, resulting in low temperature rise in operation. The plug-in cable makes it possible to change cables on the job instead of sending the tool to the toolroom.

"Oxweld" Straight-Line Cutting Machine

The Linde Air Products Co., 30 East 42nd St., New York, N. Y., has placed on the market the "Oxweld" straight-line cutting machine, which consists of a steel channel supporting base, a means for moving the blowpipe and adjustments for setting the blowpipe to cut bevels. Motion in two directions is possible: 45 in. longitudinally and 7¾ in. laterally. The machine can be furnished either with two traverse handwheels for hand operation, or one handwheel and a 110-volt universal motor. The speed of the machine is approximately 35 in. per min. A reverse switch permits motion in either direction. A steady cut is assured by roller springs that keep the gears in mesh and the carriage steady.

Wells Twist Drill Sharpener

Sharpening and rounding the corners of drills from 1 to 2½ in. is performed by the No. 26 drill sharpener built by the Wells Manufacturing Co., Greenfield, Mass. This machine is powered by ½-hp. motor and is furnished with a base or for bench use. The drill is held in a double-end collet to obtain correct alignment. At the right hand end of the motor the drills are sharpened and given the proper eccentric relief. At the left-hand end the drills are rounded on the corners. Cams make it possible to get any degree of relief desired.

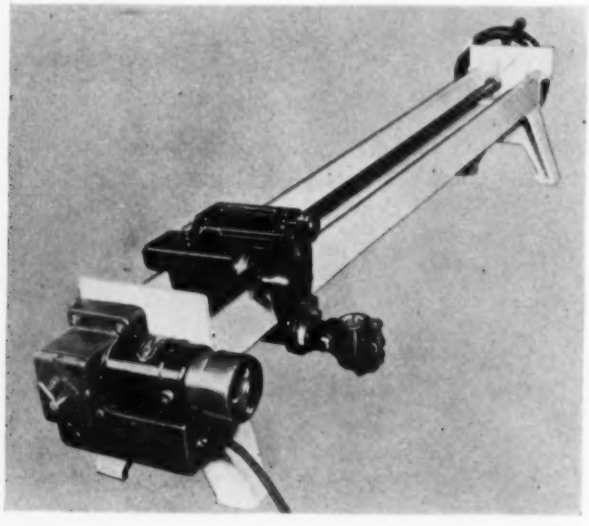
Una Automatic Arc Welding Head

An all-electric type of automatic arc welding head is being marketed by Una Welding, Inc., 1615 Collamer Ave., Cleveland, Ohio. The functions of this arc welding head are as follows: to establish the arc by first making contact between the welding wire and the work and then withdrawing the welding wire until an arc of correct length has been formed and, second, to maintain the correct length of arc under all conditions by feeding the welding wire toward the work at proper rate of travel. Either the automatic head or the work may be moved to weld the seam.

The welding head gives accurate control of arc length by the use of two independent electric motors operating against each other through differential gears. This permits instantaneous reversal of welding wire travel without reversing the direction of rotation of either motor. The front cover plate carrying the feed nozzle can be set to give angular adjustment of the welding rod with respect to the work. Feed rolls on both sides of the wire are power driven. Current is introduced to the electrode by metal brushes in the feed nozzle close to the arc so that the danger of overheating the rod is removed.

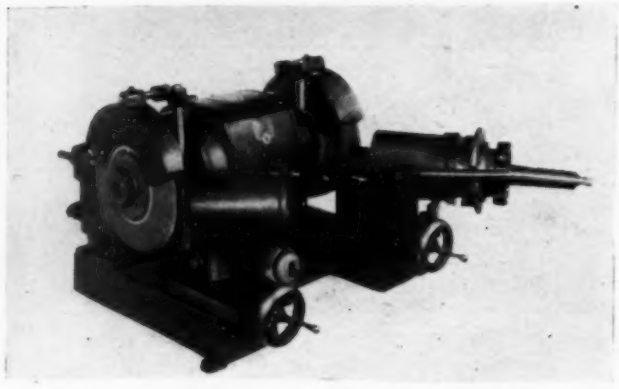
Standard 4-Way "Flex Chain" Conveyor

The Standard Conveyor Co., North St. Paul, Minn., is manufacturing 4-way "Flex Chain." Unusual flexibility is not obtained by loose-fitting connections. The connecting lugs fit in machined surfaces to give the same action as a regular pintle chain. No angle or curve is claimed to be too sharp for the chain. Smooth carrying surface permits stoppage of commodities on the chain, with the chain continuing in motion, without



Left—Oxweld Straight-Line Cutting Machine

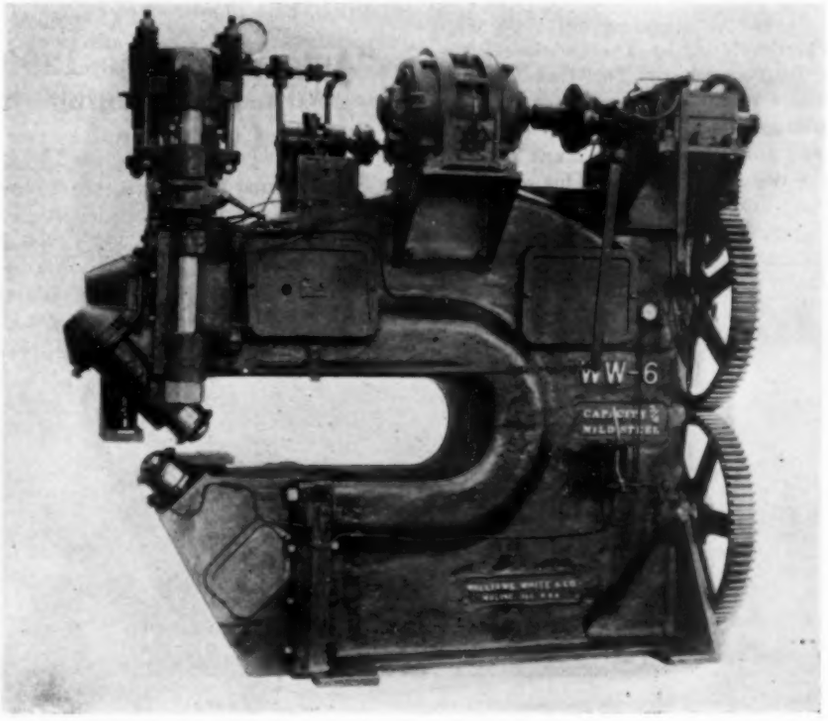
Below—Wells Twist Drill Sharpener



the usual bumping effect. The links consist of double U shapes. Ends of the links are machined to accommodate double T-shaped lugs which form the pivot for flexing. The crossbars of the double T lug are arranged at right angles so that one set of lugs permits flexing the chain in one direction and the other set in a direction at right angles to the first. The ends of the links are rounded and overlapped so that a continuous flush surface without gaps between the links is the result.

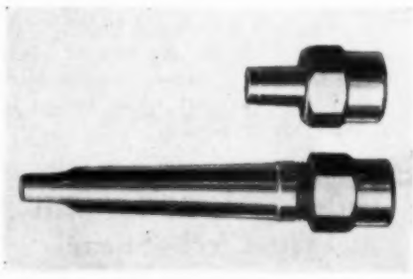
Williams, White Rotary Shearing Machines

Straight lines, circles and irregular curves in ¾-in. mild steel plate, are cut on the hydraulic rotary shearing machine developed by Williams, White & Co., Moline, Ill. The machine will cut to the center of a 96-in. circle. Three speeds are provided by a change-gear-box. The cutters are driven from a motor mounted overhead, through cast-steel gears with cut teeth. The upper cutter head has adjustment for taking up wear, and is moved downward and held by means of the hydraulic cylinder. Pressure for the cylinder is supplied by means of an individually driven rotary type pump. Outside packing is used for the ram, which transmits pressure to the upper cutter head by means of a heavy crosshead that is supported on an adjustable, positive stop. Thus, the cutters may be held under pressure at any point in their vertical adjustment. For feeding the head down, when cutting holes in the inside of a sheet or when flanging, the head is brought down to the proper cutting position by means of a feed control valve. Overloading of the machine is prevented by the hydraulic feed as the pump will bypass when the maximum safe load is exceeded.



Palmgren Collet Chucks

The Chicago Tool & Engineering Co., Inc., 8389 South Chicago Ave., Chicago, Ill., has developed a line of collet chucks for holding straight shank drills, taps, reamers and end mills. One collet chuck, illustrated, is for close-center, multiple-spindle drilling and tapping, and is balanced for high-speed drilling. The collet and nut are so interlocked that unscrewing of the nut automatically releases the collet and drill. Collets are made with Morse taper shanks, with threaded or tapered bodies to fit machine spindles, also with B.&S. shanks for milling machines and straight round shanks for turret lathes.



Hisey Wide-Range Precision Grinder

A compact precision grinder adaptable for use with lathes, boring mills, planers, milling machines and other equipment is now available from the Hisey-Wolf Machine Co., Cincinnati, Ohio. The grinder can be applied for such jobs as grinding rolls, bearings, journals, tapers, mandrels, cutters, dies, surface plates, bushings and other parts, and is suited for production work. Five sizes are built ranging from ½ to 5 hp. and using from 6 x ¾-in. to 12 x 2-in. face grinding wheels.

The Hisey grinder provides variable-speed V-belt drive to the spindle. Because the spindle housing is small it is possible to get large wheel wear. Furthermore, this feature detracts very

little from the capacity of the machine tool on which it is mounted. On most lathes any roll can be ground which can be swung over the carriage.

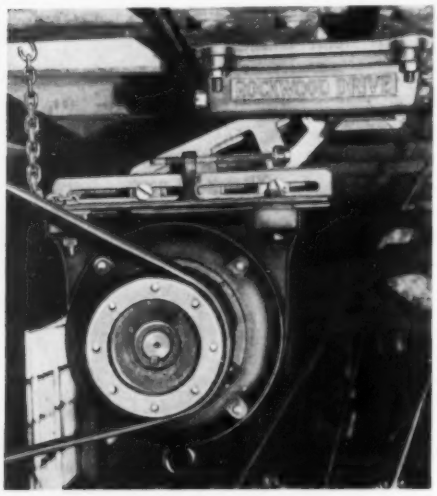
A dovetail slide affords rapid adjustment of the wheel to the center of the work but does not affect the belt tension. The grinding spindle, together with the motor, can be swung end for end so that grinding can be done either to the right or to the left. Direction of rotation of the wheel is reversible through the motor. The spindle speeds are selective because of the various pulley ratios available.

"Vibratuned" Mill-Type Incandescent Lamp

The Hygrade Sylvania Corp., 500 Fifth Ave., New York, N. Y. is producing a mill-type "Vibratuned" lamp in a 100-watt size. This lamp is particularly offered for situations where excessive vibration is present. Instead of endeavoring to produce a rigid structure to resist vibration the design of the lamp is such as to provide a flexible structure that offers no resistance to vibration and actually sways in unison with that vibration. A special wire is employed, and the filament is held by six supports as in the usual mill-type lamp.

Rockwood Ceiling Drive Base

A ceiling drive base quite similar to the standard base manufactured by the Rockwood Manufacturing Co., Indianapolis, Ind., is now being marketed. The ceiling drive base has special hanger arms which suspend the motor horizontally and give greater clearance from the ceiling. The adjustable steel angles, which move horizontally on the hanger arms, are supported by a ledge cast on the bottom of the hanger arms. This ledge carries the weight of the motor and takes the weight from the slotted-head screws in



the arm slot. The design is such that one man can quickly make any change in belt tension required without assistance while the drive is running. Design of the ledge permits the screws to be loosened and the adjustable angles to be moved along the ledge by turning the secondary arm screws. The auxiliary pair of screws on the hanger castings serve to move the motor relative to the pivot shaft without having to support the motor weight independently while the change is being made. Once the proper belt tension has been established the weight of the motor, lightly cradled in the belt, automatically keeps the belt at proper tension throughout its life. The safety chain shown insures that motor will not fall below its horizontal position even if the belt or fastener should fail.

Stanley Router and Shaper

The Stanley Electric Tool Company, New Britain, Conn., has developed a moderately priced electric router and shaper designed for woodworking and suitable for use in pattern shops. An interchangeable power unit makes possible the purchase of either a hand router,

bench router or bench shaper. The combined bench router and bench shaper is illustrated.

The motor unit is a specially designed, 110-volt universal motor with provision for mounting either a router chuck or a shaper spindle directly on the armature shaft. The unit operates at 18,000 r.p.m. The shaper table has an area of 14x10 in., and the heavy segment on the table allows the power unit to be locked at any angle up to 45 deg.

Quickwork 96-In. Mill-Type Circle Shear

Circles up to a maximum diameter of 96 in. can be cut in mild steel plate up to $\frac{3}{8}$ in. thick on a mill-type circle shear developed by The Quickwork Co., St. Marys, Ohio. The travel of the plate is 75 ft. per min. The cutters run continuously. The upper cutter is raised and lowered by a crank actuated by a swinging member. This member is swung into the path of a large stud on the periphery of the upper gear. A 15 hp. motor drives the machine. The square plate is clamped pneumatically in the circle-cutting attachment, and because of the laterally self-adjusting principle a round head with a clean square edge is cut without having first to cut off the corners of the plate. Major parts of this shear are constructed of arc-welded steel plate. All shafts, with two exceptions, are mounted on anti-friction bearings. Reduction gears run in oil.

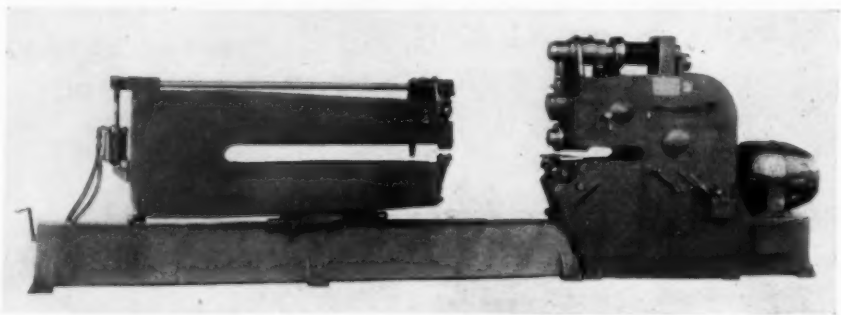
DeVilbiss Cut-Off Valve for Spray-Painting Equipment

A fluid cut-off valve has been developed by the DeVilbiss Co., Toledo, Ohio, which permits the operator to drain the spray-painting gun of fluid or to blow out any obstruction in the fluid tip without disconnecting the gun from the hose. The Type H-5135 valve is a three-way cut-off type. When the lever

is turned horizontally to the rear a port in the side of the valve is opened as the fluid passage is closed. This results in a free air passage through the valve into the fluid inlet. When the trigger is pulled, air pressure and suction drain the fluid from the fluid passage. By covering the nozzle, any obstruction in the tip may be blown back and out of the tip vent hole.

"Automatic" Type 1290 Adjustable-Timing Contactor

The Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa., is now manufacturing the Type 1290 adjustable timing contactor that will operate in any position. Power is obtained from a reversing synchronous motor and the contact arm moves alternately clock-



"Automatic" Type 1290 Adjustable-Timing Contactor

wise and counter-clockwise within the time limit set, making a 10 amp., 110 volt, a.c. load circuit for an adjustable time at either extreme of its travel. Contactors of this design are also available to be actuated from a momentary contact switch, run for the time cycle for which they have been adjusted and stop until the starting switch is again energized. These cycle-stop type contactors make and hold their load circuit at the expiration of the time set, or they may be supplied to make the load circuit at the start of the time cycle and break it when the time set has elapsed.

Millholland Piston Boring, Centering and Drilling Machine

A two-way, double-bank piston boring, centering and drilling machine has been developed by the Millholland Sales & Machine Co., 1115 East 35th St., Indianapolis, Ind. The machine bores and faces the open end and centers the closed end of the piston besides rough cross-drilling the piston-pin hole. It consists of two pairs of Millholland machine units mounted opposed on an inclined bed. The front pair of units is equipped with ball-bearing boring heads. One boring head is used for boring the open end and facing the piston and the other carries a centering drill for centering the closed end. The work is gripped by a two-jaw air chuck. The rear pair of machine units is arranged for rough drilling the pin hole after the piston has been bored.

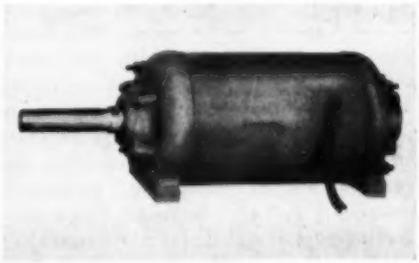
A control lever operates the lower bank of machine units, and the upper bank is likewise controlled by another control lever so that the machine operator can load from the lower bank into the upper bank or can run each bank independently. Production on this machine is 300 to 400 pistons per hour.

"Electro Lift" Twin-Hook Electric Hoist

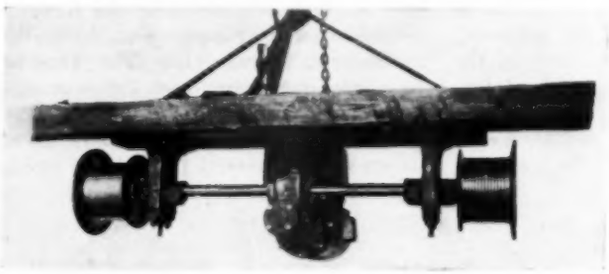
Electro Lift, Inc., 30 Church St., New York, N. Y., is now marketing a twin-hook electric hoist for handling long and bulky loads from two points. This hoist may be rigidly suspended or carried upon a trolley running on monorail track. It is built in capacities of 500 to 6000 lb. and with electrical equipment for d.c., polyphase or single-phase a.c. The two drums, operating together, are mounted on an extended drum shaft. Either rope control or automatic push button control for handling of the load may be furnished.

Allis Arbor Motor

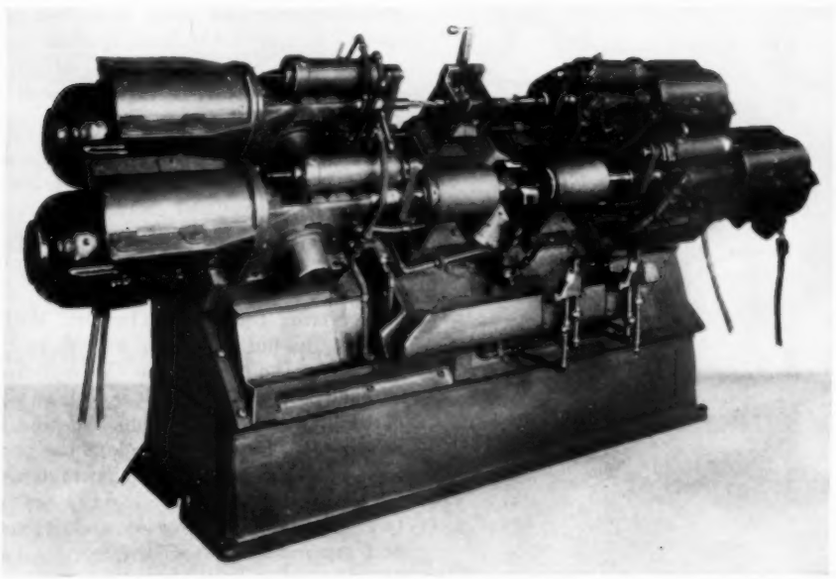
The Louis Allis Co., Milwaukee, Wis., has placed on the market a complete line of inclosed, self-ventilating arbor motors ranging in size from 2 to 10 hp. These motors are adaptable to applications where the available space for



mounting is limited. Illustrated is a 2-hp., 3,500-r.p.m., 60-cycle, open-type, ball-bearing, squirrel-cage arbor motor. End shields are provided with feet. The stator is assembled in the sheet steel housing.



Handling long and bulky loads from two points is done with the twin - hook "Electro Lift" Hoist



"Rego" GX Welding Torch

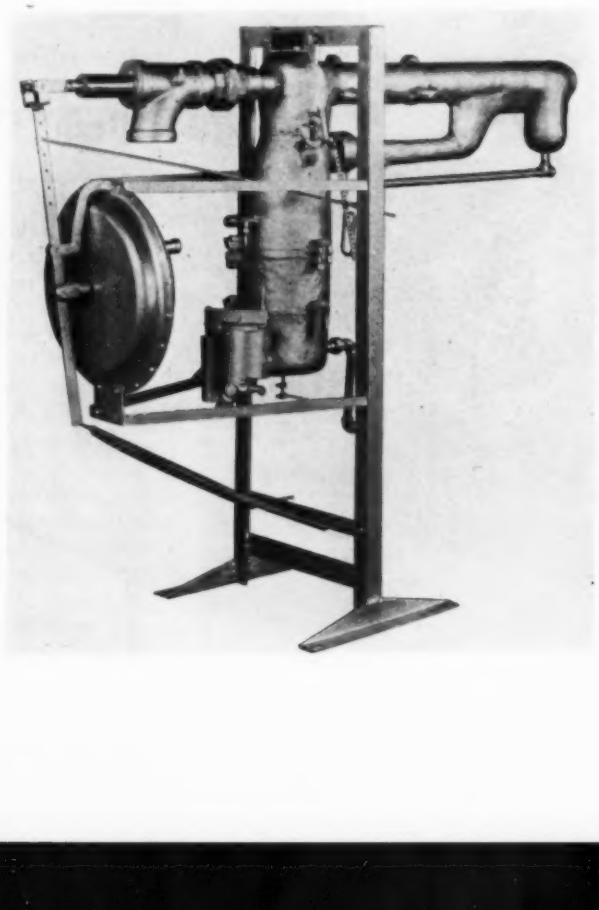
Concentration of heat is the feature of the "Rego" GX welding torch placed on the market by the Bastian-Blessing Co., 240 East Ontario St., Chicago, Ill. The long inner cone in the flame is responsible. It is the result of a streamline construction by which the mixed

gases flow through the torch without turbulence. However, the torch is not of the injector type.

The torch has an effective range of tip sizes from No. 20 to No. 72 drill size for the welding of the heaviest locomotive frames down to 24 gage sheet metal. A torch with a No. 41 tip has capacity up to $\frac{5}{16}$-in. thickness of material and weighs 23 oz. A high-speed cutting attachment with a capacity of 8 in. thickness in iron and steel can be supplied.

"Vapofier" Gas-Generating Unit

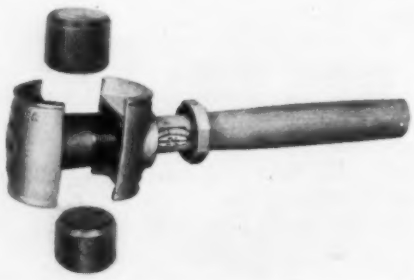
The Vapofier Corporation, 2807 South Michigan Ave., Chicago, Ill., has developed a gas-generating unit equipped with a diaphragm control for use in industrial heat applications such as heat-treating, carburizing, galvanizing, die-casting, copper annealing, japanning, enameling and core baking. The manufacturers claim that for the equivalent of every 1,000 cu.ft. of 550 B.t.u. gas, the Vapofier would require four gal. of 38-40 gravity No. 1 furnace oil, at a cost of approximately 6 cents per gal. The device is claimed to operate satisfactorily on automatic temperature control within close range and the diaphragm control automatically maintains a uniform manifold pressure in the gas supply line. Neutral, oxidizing or reducing flame characteristics can be achieved. By using the pre-mixing principle, the Vapofier generates gas from No. 1 furnace oil, pre-mixes this gas with the proper proportions of air and then conveys the pre-mixed gas to the burners.



Generation of gas from No. 1 furnace oil and pre-mixing with air is accomplished by this Vapofier unit which is intended for industrial heat applications

"Basa" Rawhide-Face Hammer

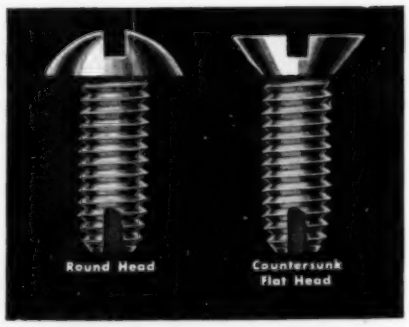
A "Basa" hammer with two adjustable rawhide faces has been placed on the market by Greene, Tweed & Co., 109 Duane St., New York, N. Y. The adjustable metal head holds the rawhide faces firmly. Each jaw is recessed



to mushroom the rawhide at the back and thus to prevent the face from falling out. When the faces become worn they can be replaced with refills. The handle of the hammer is made of straight-grained hickory.

"Tapster" Hardened Self-Tapping Screws

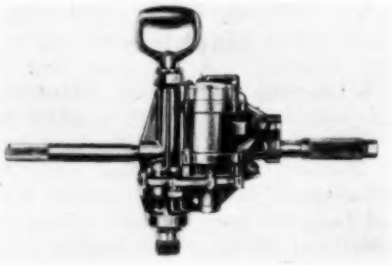
A standard thread is employed on the hardened self-tapping screw known as the "Tapster," marketed by the Kellogg Switchboard & Supply Co., 1066 W. Adams St., Chicago, Ill. The Tapster has balanced flutes and twin-cutting edges and is said to accomplish a tapping operation at the same time it is driven and not merely to push the metal



aside. Since it cuts a thread to exactly fit its own thread, the fit is tighter than that of ordinary machine screws in tapped holes. The Tapster can be withdrawn and redriven without injury to itself or the threaded hole. It is said that the problem of screws tilting when being driven has been overcome because the threads guide the screw when it is started. The Tapster is available in all standard sizes with standard heads as well as in any plated finish with special heads.

Thor Boiler Shop Drill

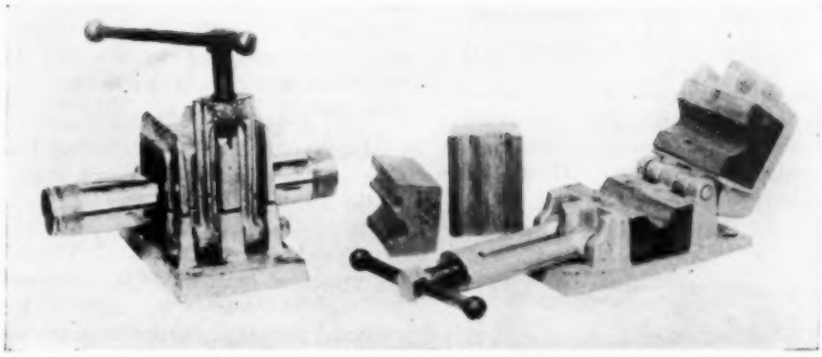
A pneumatic boiler shop drill has been developed by the Independent Pneumatic Tool Company, 600 West Jackson Blvd., Chicago, Ill., and is equipped with power blades instead of connecting rods,



pistons and crankshafts. The drill has governor controlled air consumption and speed. Is adapted to both staybolt tapping and flue rolling. Drilling and reaming capacity is up to 1¼ in. Speed is 210 r.p.m. The weight is 28 lb., and the length is 12 in.

"Velvo-Grip" Wrench and Vise

Wolverine Industries, Harbert, Mich., are now manufacturing a wrench and a vise under the trade name "Velvo-Grip." The purpose of these tools is to hold any material without scratching, crushing or injuring it. Each tool employs the principle of cushioning its grip on materials by the use of wood jaws. Jaws are interchangeable in the vise and wrench and are made of standard 2x4 lumber.



"Velvo-Grip" Vise with wood cushioning jaws

The vise consists of a two-part malleable iron frame, a set of cushion jaws for standard-size materials as ordered and a screw yoke. The wrench depends on a cam action for its grip. Jaws for clamping special irregular shaped materials are easily made.

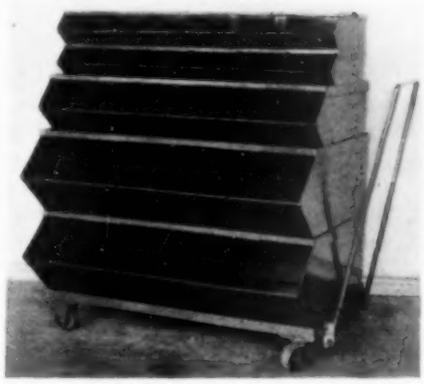
Stanley Flexible-Rigid Steel Rules

The Stanley Rule & Level Plant, Stanley Works, New Britain, Conn., has recently brought out three "Pull-Push" rules of flexible-rigid construction. The blade can be removed entirely from the

case and used for end-to-end measurements. Other features are: nickel plated blades; safe "Pull-Push" blade action; graduations lie close to the work; watch size cases, only 2 in. in diameter. The cases can be had in various finishes.

Stackbin Assembly Truck

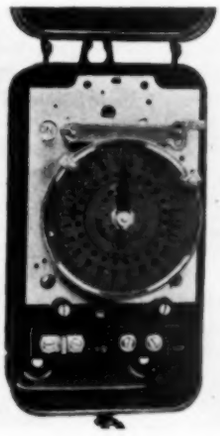
Various parts required in an assembly can be loaded on the Stackbin assembly truck at the general stockroom and then moved to the assembly department where the truck serves as a small portable stockroom. The truck has storage compartments of graduated size. Bulky



castings are placed in the larger compartments at the bottom, medium-size parts in compartments at about the middle, and small items such as screws, bolts, nuts and cotter pins in the top sections. The standard Stackbin sections are stacked on an angle-iron platform frame attached to two 3-in. swivel casters and two 3-in. stationary casters. The assembly truck is manufactured by the Stackbin Corporation, Providence, R. I.

General Electric Type T-15 Automatic Time Switch

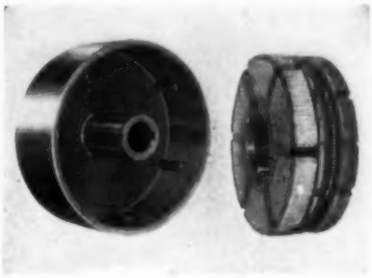
The Type T-15 automatic time switch, a companion to the Type T-13 general-purpose automatic time switch, has been



announced by the General Electric Co., Schenectady, N. Y. This switch is for indoor service, has no cover gasket, is finished in black lacquer. The switch uses a Telechron motor for timing device and mercury-to-mercury "Kon-nector" switches. Two adjustable riders, "on" and "off," give two operations every 24 hr. Additional riders may be installed to give more operations daily. The 30 amp. switch is available in 12 forms and for either 115 or 230 volts.

Zobell-Waterhouse Coupling

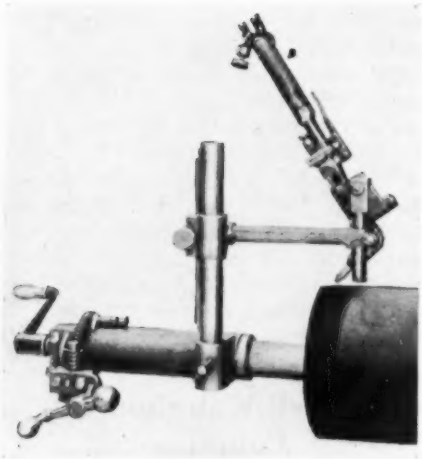
The Zobell Electric Motor Corp., Garwood, N. J., is now marketing a "Zobell-Waterhouse" coupling designed to disengage a driven machine when subjected to excessive overload. The coupling consists of a starting section and a service section. Each section consists of a ring of segments operated by centrifugal



force. Starting-section segments are rotated by the drive shaft, are held in contact with central body section by a garter spring designed to give the required starting torque but to release under the centrifugal force developed at a speed less than the full-load speed. Service-section segments rotated by the driven shaft are designed so that centrifugal force at load speed allows this section to carry the full load. When an overload slows down the driven machine, the service section disengages and disconnects the drive, which then runs free. To reset, the driving motor is stopped and restarted.

Oxweld Pipe Cutting and Beveling Machine

The Linde Air Products Co., 30 East 42nd St., New York, N. Y., is now marketing an Oxweld pipe-cutting and beveling machine that will take almost any hand-cutting blowpipe, is readily portable and can be used to cut and bevel pipe in large quantities. The machine consists of a center rod with three spreading arms that press against the inner wall of the pipe, holding it in po-

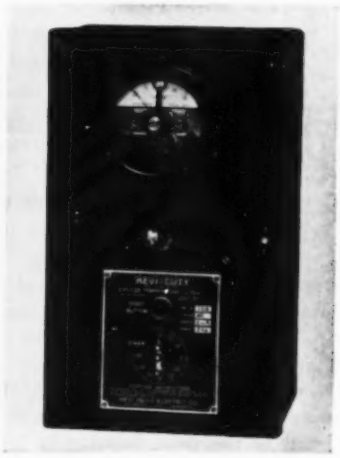


Oxweld Pipe Cutting and Beveling Machine

sition. An arm supports the blowpipe which can be adjusted to the desired angle of cut. The blowpipe and arm rotate without the use of a crank for quick centering of the device and by means of the crank when doing actual cutting.

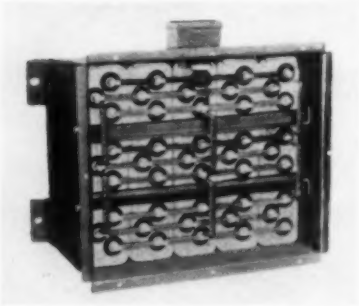
Hevi-Duty Excess Temperature Cut-Out

Protection against heating a charge beyond a safe temperature is afforded by a cut-out developed by the Hevi-Duty Electric Co., Milwaukee, Wis. The device can be applied to such equipment as gas, oil and electric heating apparatus. A thermocouple located in the heating chamber actuates the cut-out instrument, which in turn operates the cut-out control relay. This relay is connected to form part of the main heating control circuit. The adjustable target is provided for setting the instrument at the desired "kick-out" temperature. A pilot lamp indicates whether the cut-out circuit is open or closed. Where no control equipment is employed the device can be connected to flash a light or sound an alarm.



"Ideal" Capacitors for Power-Factor Correction

The Ideal Electric & Manufacturing Co., Mansfield, Ohio, has developed a line of capacitors (static condensers) for power-factor correction. These capacitors have an efficiency of 99¾ per cent,



and have a low temperature rise of 2 deg. C, and comprise an assembly of small independent, hermatically sealed-can units. They are made for all voltages up to 4,600 and for any frequency and phase arrangement and in any size desired.

• TRADE PUBLICATIONS •

BUSHINGS. Bulletin No. 339, issued by the Johnson Bronze Co., New Castle, Pa., lists phosphor-bronze bushings in standard stock sizes ready for machine assembly.

COSTS. The Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y., published a pamphlet, "Uniform Cost Activities in Trade and Industry," which is the result of a review of the uniform cost experiences of more than 76 trade associations. Procedures entailed in administering uniform cost activities and methods of preparing uniform cost accounting manuals are discussed.

FILTERED PLATING SOLUTIONS. Removal of suspended matter from plating baths is discussed in a pamphlet "Improved Filtration Cuts Plating Costs," published by T. Shriver & Co., Hamilton St. & Franklin Ave., Harrison, N. J. The use of the company's filter presses for this purpose is mentioned.

OPTICAL GEAR TESTER. Catalog 563 of the Societe d'Instruments de Physique, Geneva, Switzerland, for which The R. Y. Ferner Co., 1133 Investment Bldg., Washington, D. C., is American representative, describes an apparatus for rapid tests on spur and helical gears between 0.16 and 4 in. in diameter and from 50 to 10 D. P. Readings of pitch and eccentricity are made from the projection of a rectangular shadow on a glass screen.

MACHINING SYNTHANE. The Synthane Corp., Oaks, Pa., has prepared another in the list of circulars, this one being entitled "Instructions for Machining Synthane Laminated Bakelite." The data are presented in chart form under such headings as bandsawing, milling, gear cutting, drilling, punching, threading, turning and boring, and are unusually complete.

MATERIALS HANDLING. Bulletin 160, available from the Mercury Manufacturing Co., 4118 South Halsted St., Chicago, Ill., describes the "Banty" gas tractor and the Type A-310 trailers for making up "trackless" trains for materials-handling systems in industrial plants.

MOTORS. The Crocker-Wheeler Electric Mfg. Co., Ampere, N. J., has published "Crocker-Wheeler Products," a resume of its line of motors, generators, motor generator sets and other equipment.

MOTOREDUCERS. The Falk Corp., Milwaukee, Wis., is distributing Bulletin No. 270 describing its "Motoreducers" to which several new additions have been made. These combined speed reducers and motors are thoroughly described and specifications are listed. A number of shop views of installations are presented.

MOTORIZED MACHINE TOOLS. A four-page circular entitled "Machine Tools," issued by the Wagner Electric Corp., St. Louis, Mo., illustrates honing, milling, drilling, reaming, tapping, threading, grinding and other machine tools operated by the company's totally inclosed fan-cooled Type CP motors.

SHAFT COUPLINGS. The Link-Belt Co., 519 North Holmes Ave., Indianapolis, Ind., has published an illustrated catalog on flexible shaft-couplings of three different types. Special emphasis is given to the Type "RC" which employs Link-Belt "Silverlink" roller chain.

TAP SHARPENERS. A four-page folder published by the Wells Manufacturing Co., P. O. Box 613, Greenfield, Mass., shows four types of tap sharpeners and two drill sharpeners and corner rounders.

THERMOMETERS AND PRESSURE GAGES. Catalog No. 6702, published by the Brown Instrument Co., Philadelphia, Pa., illustrates a new line of indicating, recording and controlling thermometers and pressure gages. The catalog comprises 80 well illustrated pages.